Navigation Improvement Study
Detailed Project Report and
Environmental Report

Draft

Aunt Lydia's Cove
Chatham, Massachusetts

US Army Corps
of Engineers
New England Division

December 1991

AUNT LYDIA'S COVE

CHATHAM, MASSACHUSETTS

NAVIGATION STUDY

DETAILED PROJECT REPORT

DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

NEW ENGLAND DIVISION

EXECUTIVE SUMMARY

This report presents the results of a study to determine the feasibility of Corps of Engineer involvement in providing navigation improvements at Aunt Lydia's Cove and in Chatham Harbor, Chatham, Massachusetts.

Aunt Lydia's Cove is a moderate size commercial boat harbor located on the east side of Chatham in Chatham Harbor. The Chatham Municipal Fish Pier is the focal point of a 69 vessel commercial fishing fleet based at the cove. The facility is used to off-load catch, take on supplies, and perform some boat repairs. The cove is also home port for two of the Coast Guard's rescue vessels.

In January 1987, Nauset Beach, a barrier beach located east of Chatham, was breached. The breach is approximately one and a half miles wide today. As a result of the exposure to the open ocean, a very dynamic shoaling problem as well as increased wave action in the area of Aunt Lydia's Cove now exists. This has resulted in increased damages and delays to the fishing vessels along with increased damages to the Municipal Fish Pier. Several plans were developed and evaluated that would alleviate as many of the damages and delays to the fishing vessels and damages to the fish pier as possible. These plans included: the no action alternative, moving the commercial fleet to nearby Stage Harbor, establishing a Federal channel south or north of Tern Island, constructing a small breakwater, or constructing a jetty combined with a channel south of the cove.

The no action alternative would result in the spar channel shoaling to a depth of -1 foot at Mean Low Water (MLW). This depth prevents deeper draft vessels from entering the cove even at high tide. This already occurring situation, has resulted in some fishermen offloading their vessels, outside the cove, into skiffs. This is a time consuming and dangerous process that will eventually force the larger vessels to relocate to other ports or go out of business. Some have already moved to harbors on the south side of the Cape. Aunt Lydia's Cove would become a tidal port, accessible to only the shallow draft boats at the higher tidal stages. Operation of the U.S. Coast Guard's 44-foot rescue vessel would be severely restricted due to having to moor outside the cove. Waves and swells would continue to cause damages to vessels and the town pier.

Plan A, moving the fleet to Stage Harbor, would result in significant added steaming costs for many of the vessels as they travel around Monomoy Island. This added cost outweighed the benefits to be realized. Though not examined in great detail, an estimate for providing additional anchorage space and the construction of similar offloading facilities made the plan less feasible. The benefit to cost ratio of this plan, even without necessary capital improvement costs by the town, is estimated to be 0.4.

Plan B, establishing a Federal channel south of Tern Island, would require maintenance several times per year, in the area of Aunt Lydia's Cove, in order to maintain the desired dimensions. Several maintenance alternatives were examined including: purchasing a small dredge as part of the project and having a contractor do the work several times per year.

Several disposal alternatives were also considered including: the use of a confined disposal facility (CDF) on Tern Island, placing the material loosely on Tern Island, and pumping or mechanically removing the material to eroded shorelines south of the cove. As a result of policy and disposal restrictions it was found that regular maintenance of this plan would be very costly and resulted in a benefit to cost ratio of 0.5.

Plan C, a channel north of Tern Island, would not require as much maintenance dredging as Plan B but is still estimated to require an 8 month maintenance cycle. In terms of dredging and disposal methods this plan is similar to Plan B. This plan would involve the removal of several acres of intertidal habitat, which would require mitigation measures. Maintenance dredging of this plan on an eight month cycle would result in a benefit to cost ratio of 0.7.

Plan D involved constructing a small stone breakwater to protect the Municipal Fish Pier. This plan would reduce the amount of wave and swell damages currently being experienced in the cove. The benefit to cost ratio of this plan was found to be 0.6.

Finally, Plan E would entail contructing a stone jetty and a channel similar to that of Plan B. This plan would also hinder wave and swell attack but also reduce some of the shoaling being experienced at the southern end of Aunt Lydia's Cove. Though reduced, annual maintenance is still anticipated for this plan. The benefit to cost ratio was determined to be 0.5.

Each channel improvement cost estimate was affected by frequent and expensive maintenance costs and a lack of available nearby long term disposal sites. Project benefits were limited to a certain extent by depths across the breach in Nauset Beach. Alternative plans were examined that included deepening the breach, but the additional benefits that would acrue with this improvement were far outweighed by the additional costs of that feature.

The Division Engineer, owing to a lack of economic justification, concludes that Federal participation in any Federal navigation improvement project at Aunt Lydias Cove, Chatham, Massachusetts is not warranted at this time.

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INTRODUCTION

Study Authority

This Detailed Project Report (DPR) is the result of an engineering, economic and environmental feasibility study of navigation improvements at Aunt Lydia's Cove, Chatham, Massachusetts. The DPR is prepared and submitted under the authority and provisions of Section 107 of the 1960 River and Harbor Act, as amended.

Study Purpose and Scope

The town of Chatham is located at the "elbow" portion of what is known as Cape Cod, in eastern Massachusetts. Chatham is bordered to the north by Pleasant Bay and Orleans, to the east by the Atlantic Ocean, to the south by Nantucket Sound, and to the west by the town of Harwich (see Figure 1). A ten mile long barrier spit system, called Nauset Beach, separates the areas of Pleasant Bay and Chatham Harbor from the Atlantic Ocean. Nauset Beach, until recently, protected the eastern shore of Chatham from the Atlantic Ocean. In January 1987, Nauset Beach was breached during a severe storm. The breach has since grown to a width of approximately 1.5 miles.

Aunt Lydia's Cove, located on the eastern shore of Chatham Harbor and just northwest of the newly formed breach, is home port to a moderately sized commercial fishing fleet. Whereas the breach now offers fishermen a shorter, more direct route to the fishing grounds off the east coast of Cape Cod, it has also created some very complex problems. The opening of the breach has resulted in a release of great quantities of sand into Chatham Harbor and Pleasant Bay, a change in tidal levels and currents, and exposure of the inner shoreline to direct wave attack from the Atlantic Ocean.

A Congressionally authorized General Investigation Reconnaissance study of the impacts of the coastal breach in Pleasant Bay was initiated in September 1987. The reconnaissance study found that there was a Federal interest in navigation improvements to Chatham Harbor and that further, more detailed investigation of these improvements could be pursued under the Corp's Section 107 Continuing Authority Program.

The purpose of this study is to further evaluate the problems being experienced by the boaters based in Aunt Lydia's Cove and determine a solution, if any, that is most economically beneficial. The scope of this Detailed Project Report provides for the following:

- Identifying existing conditions and historical trends within the study area,
- Determining the navigation problems and needs of the area.
- Determining the most probable future condition without Federal improvements,
- Developing plans of improvement,
- Evaluating and comparing the engineering, economic, environmental, and social impacts of the various plans, with respect to the future condition,

- o Recommending improvements that are implementable, economically feasible, environmentally and financially acceptable, and socially beneficial.

The geographic scope is:

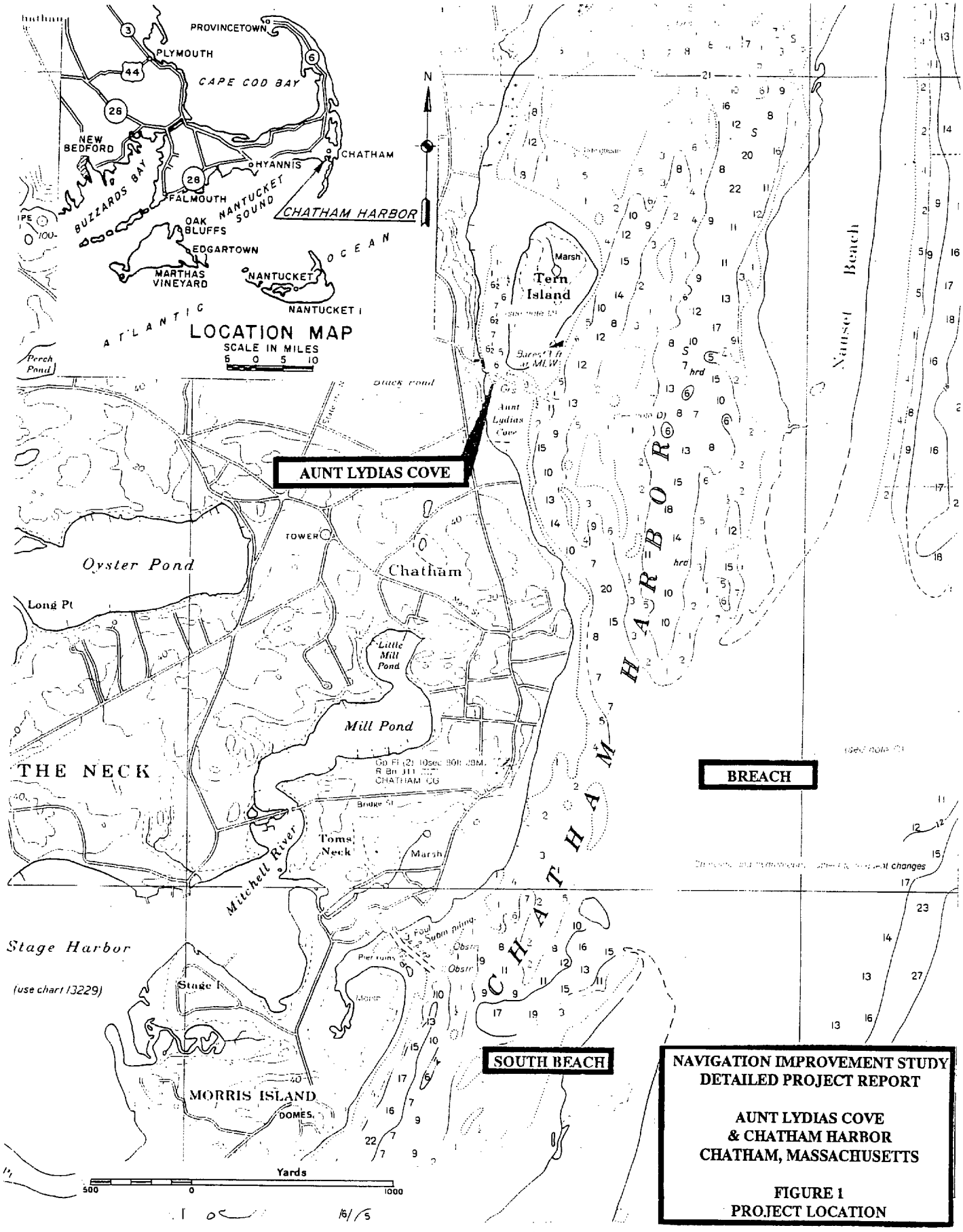
- o The areas in and around Aunt Lydia's Cove,
- o Areas of possible impacts beyond the immediate vicinity of Aunt Lydia's Cove, including alternative harbors in which to relocate the fleet, the dredged material disposal sites, and the areas from which resources are harvested by the commercial fleet.

Prior Studies and Improvements

Navigation improvements in the Chatham Harbor area were recommended in the Pleasant Bay Survey Report dated November 1968. The recommendation included various size channels and anchorages throughout Pleasant Bay, a jetty stabilized inlet in Nauset Beach, a 20-foot deep channel through the created inlet, provision of a sand dike between the end of Nauset Spit and north end of Monomoy Island, and a dune rebuilding program to preserve Nauset Beach and reduce shoaling in the channels (see Figure 2). The project was authorized by the River and Harbor Act of 1970. A reconnaissance report was completed in September 1979 to evaluate several "scaled down" versions of the 1970 authorized project. None were found to be economically justified. In fact, the report went so far as to state that construction of anything less than that of the authorized project would not be effective. Funding of the local share for construction of the authorized work was never secured and the project was deauthorized in the Water Resources Development Act of 1986.

The only existing Federal project in the Chatham area is located at Stage Harbor, approximately 1.5 miles southwest of Aunt Lydia's Cove. The project provides access to Nantucket Sound. The original improvement was completed in 1901 and consisted of a 6-foot deep channel running through the bars at the eastern end of Harding Beach. The existing project, a channel 10 feet deep and 2.1 miles long, was authorized in 1945 and constructed in 1957. Relocation of the 10-foot channel through Harding Beach, construction of a sand dike across the old harbor mouth and a 200 foot long jetty along the new channel were completed in July 1965 (see Figure 3). Modification of the jetty was completed in December 1967. The Stage Harbor channel has needed regular maintenance since its 1965 relocation, as evidenced by the following:

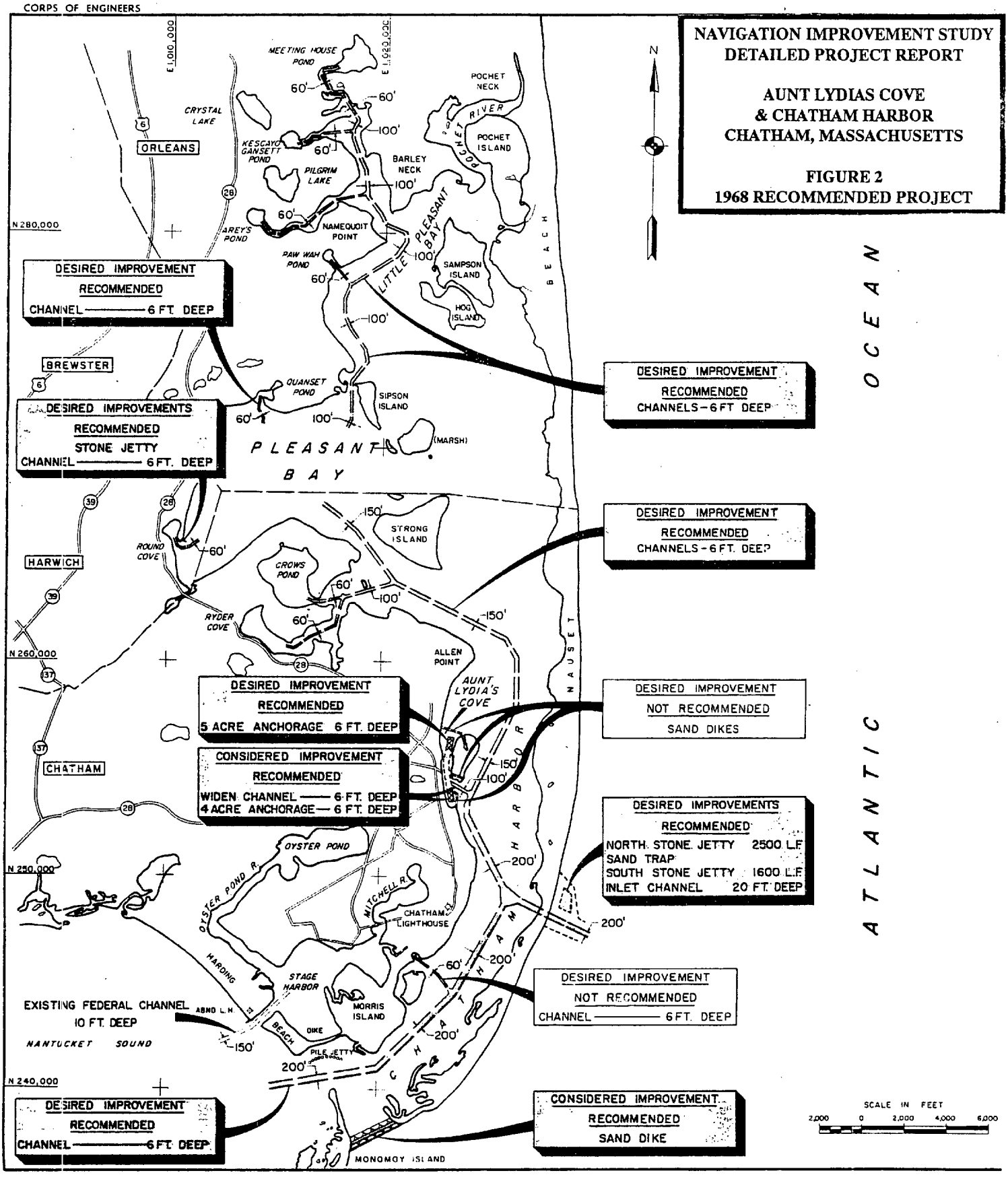
Year	Maintenance Completed
1970	Dredging of 30,000 cubic yards of sand
1973	Dredging of 8,000 cubic yards of sand
1974	Dredging of 14,000 cubic yards of sand
1976	Dredging of 8,000 cubic yards of sand
1977	Dredging of 7,000 cubic yards of sand
1978	Dredging of 52,000 cubic yards of sand
1984	Dredging of 120,750 cubic yards of sand
1987	Dredging of 117,000 cubic yards of sand
1990	Dredging of 150,000 cubic yards of sand
1991	Dredging of 22,000 cubic yards of sand



NAVIGATION IMPROVEMENT STUDY
DETAILED PROJECT REPORT

AUNT LYDIAS COVE
& CHATHAM HARBOR
CHATHAM, MASSACHUSETTS

FIGURE 1
PROJECT LOCATION


CORPS OF ENGINEERS
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AUNT LYDIAS COVE
& CHATHAM HARBOR
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FIGURE 2
1968 RECOMMENDED PROJECT
N
E 1,010,000
E 1,020,000
N 280,000
N 260,000
N 250,000
N 240,000
MEETING HOUSE POND
CRYSTAL LAKE
ORLEANS
KESCAYO GANSETT POND
AREY'S POND
PILGRIM LAKE
BARLEY NECK
POCHET NECK
POCHET RIVER
POCHET ISLAND
NAMEQUOIT POINT
PAW WAH POND
PLEASANT BAY
LITTLE PLEASANT BAY
SAMPSON ISLAND
HOG ISLAND
BEACH
OCEAN
BREWSTER
QUANSET POND
SIPSON ISLAND
(MARSH)
PLEASANT BAY
HARWICH
ROUND COVE
STRONG ISLAND
CROWS POND
RYDER COVE
ALLEN POINT
AUNT LYDIA'S COVE
NAUSET
CHATHAM
HARBOR
ATLANTIC
OYSTER POND
OYSTER POND R.
MITCHELL R.
CHATHAM LIGHTHOUSE
HARDING
STAGE HARBOR
MORRIS ISLAND
DIKE
BEACH
PILE JETTY
ABND L.H.
EXISTING FEDERAL CHANNEL
10 FT. DEEP
NANTUCKET SOUND
MONOMOY ISLAND
DESIRED IMPROVEMENT
RECOMMENDED
CHANNEL — 6 FT. DEEP
DESIRED IMPROVEMENTS
RECOMMENDED
STONE JETTY
CHANNEL — 6 FT. DEEP
DESIRED IMPROVEMENT
RECOMMENDED
CHANNELS - 6 FT. DEEP
DESIRED IMPROVEMENT
RECOMMENDED
CHANNELS - 6 FT. DEEP
DESIRED IMPROVEMENT
RECOMMENDED
5 ACRE ANCHORAGE 6 FT. DEEP
DESIRED IMPROVEMENT
NOT RECOMMENDED
SAND DIKES
CONSIDERED IMPROVEMENT
RECOMMENDED
WIDEN CHANNEL — 6 FT. DEEP
4 ACRE ANCHORAGE — 6 FT. DEEP
DESIRED IMPROVEMENTS
RECOMMENDED
NORTH STONE JETTY 2500 L.F.
SAND TRAP
SOUTH STONE JETTY 1600 L.F.
INLET CHANNEL 20 FT. DEEP
DESIRED IMPROVEMENT
NOT RECOMMENDED
CHANNEL — 6 FT. DEEP
DESIRED IMPROVEMENT
RECOMMENDED
CHANNEL — 6 FT. DEEP
CONSIDERED IMPROVEMENT
RECOMMENDED
SAND DIKE
SCALE IN FEET
2,000 0 2,000 4,000 6,000

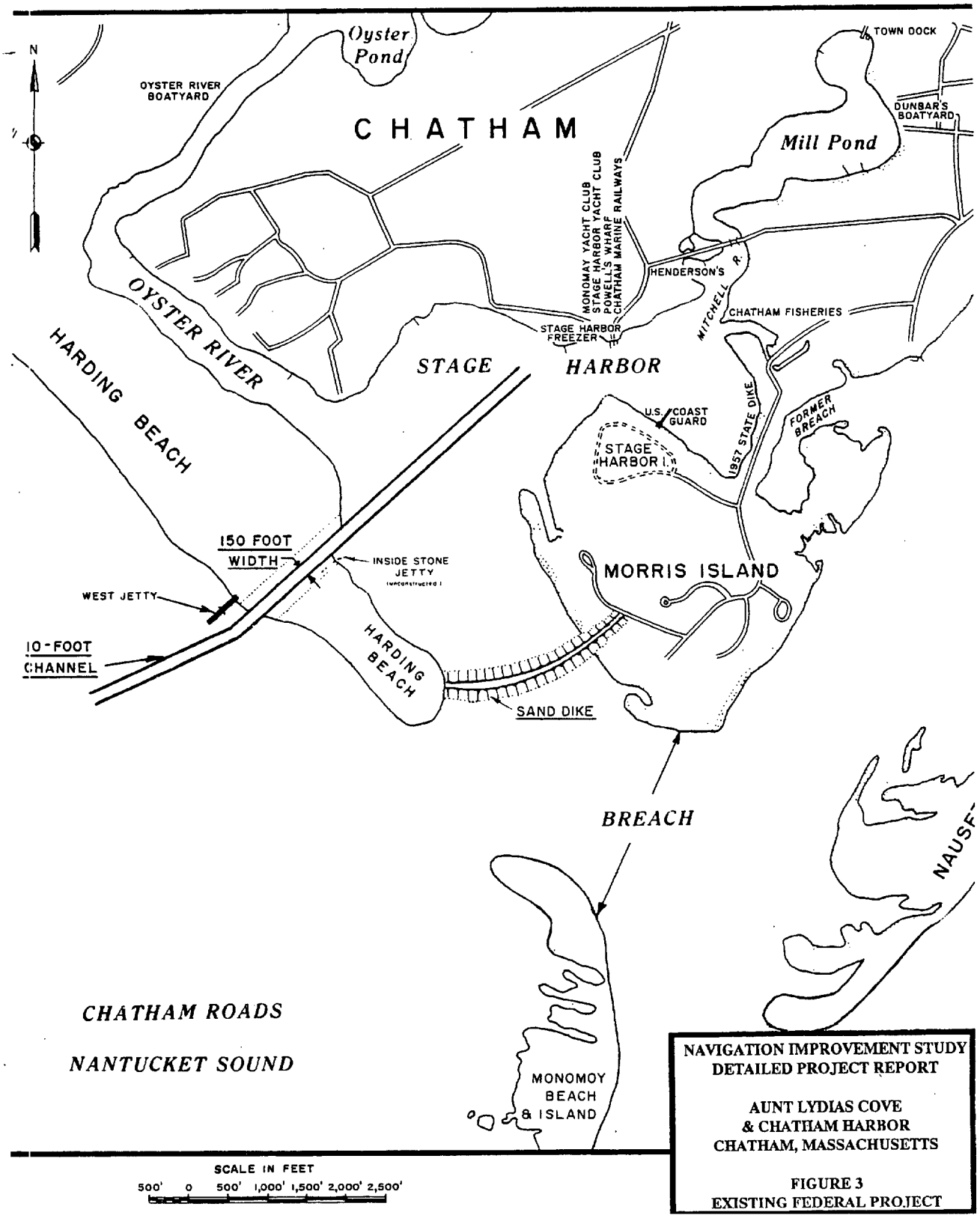

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FIGURE 3
EXISTING FEDERAL PROJECT

Study Participants and Coordination

The preparation of this report required the close cooperation of Federal agencies, State and local government agencies, elected officials of the State and local governments, local commercial fishermen and other concerned citizens. This Section 107 Feasibility Study was cost-shared 50/50 between the U.S. Army Corps of Engineers and the local sponsor, the town of Chatham in conjunction with the Massachusetts Bureau of Coastal Engineering.

The Report and Decision Process

This Detailed Project Report summarizes the investigation of plans for providing navigation improvements for the fishermen based in the area of Aunt Lydia's Cove. The initial steps in the study included a comprehensive inventory of available information and "brainstorming" of all possible alternatives. Extensive efforts were then made in contacting public officials and concerned parties from the town to allow a free exchange of information and seek input in the study process. As a result of these meetings, planning objectives and constraints were determined and used to narrow the list of plans that were actually studied in detail. A public meeting and several workshops, conducted with fishermen, Coast Guard personnel, concerned citizens, and various resource agencies were critical to the study's completion.

A hydrographic survey, environmental testing and sampling, archealogical investigations, economic studies, and engineering analysis of the alternative plans was conducted. Sponsors of the study kept in close contact during all phases of the study to ensure agreement on the study's direction and progress.

PROBLEM IDENTIFICATION

This portion of the report discusses the nature and scope of navigation problems in Chatham Harbor and establishes the planning objectives and constraints that direct subsequent planning tasks.

Existing Conditions

The town of Chatham is located approximately 90 miles southeast of Boston, 17 miles east of Hyannis and 223 miles northeast of New York City. Access to Chatham is provided by Massachusetts routes 28 and 137.

In 1980 the year round population of Chatham was approximately 6,700. In 1990 this figure was expected to go as high as 7,200. During the summer season the overall population of the town triples due to the influx of vacationers. The shoreline, various naturally preserved areas, and the town's many historic sites make the town a popular place for vacationers and visitors alike.

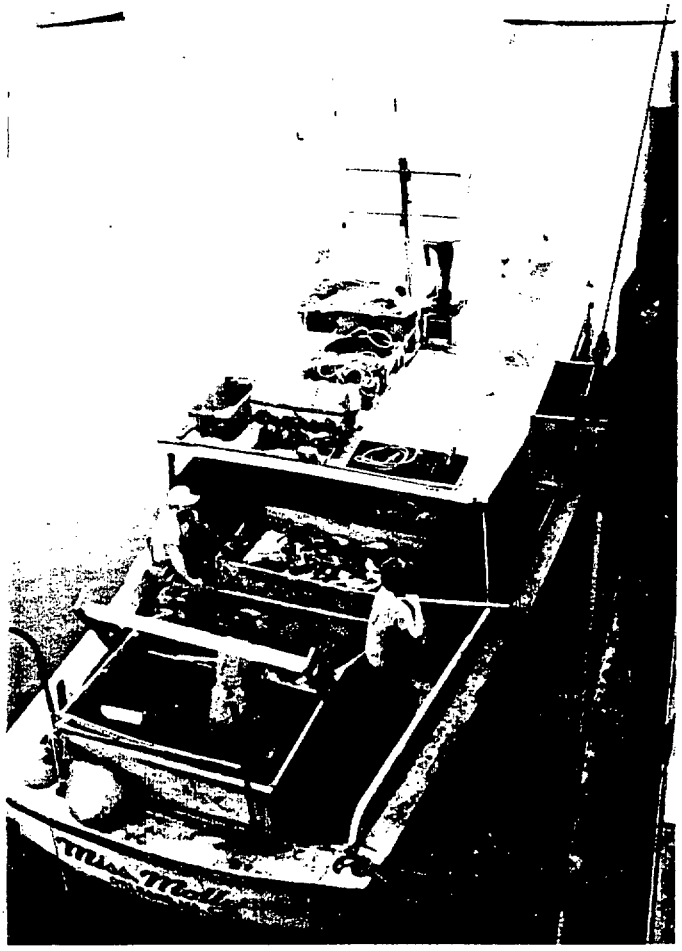
Chatham, bordered to the north by Pleasant Bay, the east by Chatham Harbor, and the south by Nantucket Sound, is a very popular area for both commercial and recreational boaters. There are currently 246 commercial fishing vessels and hundreds more recreational vessels registered in Chatham. Chatham Harbor is an area formed between Nauset Beach, a part of the Cape Cod National Seashore, and the eastern Chatham shoreline. The protected confines of Chatham Harbor and Pleasant Bay have traditionally made it a very good boating area. Boaters wishing to access the Atlantic Ocean made a 2 to 3 mile run to the south around the tip of Nauset Beach.

Aunt Lydia's Cove is the main commercial fishing base in Chatham. Located approximately 1 mile south of Allen Point in Chatham Harbor, the cove is bordered to the north and south by tidal flats and is partially protected to the east by Tern Island.

The Chatham Municipal Fish Pier is located in Aunt Lydia's Cove. Initially constructed in 1945, the pier is used to off-load catch, access boats, load supplies and perform some repairs. Transient boats also use the pier for offloading catch and taking-on supplies. Recreational boaters sometimes use the facility for refueling. Two independent fish companies lease space at the pier's main packing facility where fish is offloaded, packed in ice, and shipped to various distributors and buyers. Two large ice producing machines are located in the fish plant. The pier provides diesel fuel, gasoline, parking, and restroom facilities. The pier is also a tourist attraction as it offers visitors to the town an opportunity to observe firsthand the operations of a New England fishing port (see Figure 4).

As of early 1991, 69 commercial fishing vessels hold permits to offload at the Chatham Municipal Fish Pier. Of this total, approximately 29 vessels moor in Aunt Lydia's Cove. The rest of the fleet moors outside of Tern Island in Chatham Harbor. While most of the fleet is outfitted for longlining, jigging, and gillnetting there are a few draggers, lobster vessels and other shellfishing craft. Many of the fishermen are flexible and able to rig their vessel for several different types of fishing. The

Commercial Anchorage At Aunt Lydias Cove



Fishing Vessel Offloading At Chatham Municipal Fish Pier

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AUNT LYDIAS COVE
& CHATHAM HARBOR
CHATHAM, MASSACHUSETTS

FIGURE 4
PHOTOGRAPHS

commercial vessels accessing Aunt Lydia's Cove range in length from 19 to 50 feet and the drafts of these vessels range from 1.5 to 8 feet. Fleet statistics show that the average fishing vessel is 37 feet long and draws 4 feet of water.

There are 6 recreational vessels that currently moor in Aunt Lydia's Cove. These vessels are all 20 feet in length or less and draw 1 to 2 feet of water. As stated previously, other recreational vessels that access the cove are usually there to purchase fuel. Whereas the recreational vessels can obtain fuel in several spots throughout Chatham Harbor and Pleasant Bay, nearly all commercial vessels obtain their fuel from the Municipal Fish Pier.

The U.S. Coast Guard operates a 44-foot motor life boat and 28-foot rapid response boat out of Aunt Lydia's Cove. A vessel is also based at Stage Harbor. Due to the geographic configuration of the outer Cape, vessel placement in both areas is necessary to provide adequate service for the waters north and east of Chatham as well as the Nantucket Sound area.

On January 2, 1987 a breach of Nauset Beach occurred during a northeast storm, in an area just opposite the Coast Guard Lighthouse in Chatham. Initially the opening was 20 feet wide. In three months the breach had grown to approximately 3,000 feet and by September 1988 it was over 6,000 feet wide. Today, the breach is approximately a mile and half wide. The remaining portions of Nauset Spit are referred to as North and South Beaches. The tidal flushing of Pleasant Bay now occurs through the breach as opposed to the old Chatham Harbor inlet. This has in turn allowed the partial welding of South Beach to the mainland. As the breach has widened, the addition of eroded sand into Chatham Harbor has caused extensive ebb and flood tidal shoals inside the harbor and outside the breach.

Studies have shown that the breaching of Nauset Beach is cyclical in nature. Though the most recent breach did not occur exactly in the area expected, experience and scientific study agree in theory to the breach's future course. North Beach will eventually cease retreating. South Beach, which is cut off from its supply of nourishing sand, will continue to "peel back"; eroding and attaching to the mainland and Monomoy Island. North Beach will begin to grow to the south as a result of net littoral drift in that direction. Nauset Beach will grow to lengths similar to those of pre-breach years at which time, an estimated 100 to 150 years from now, the process is expected to repeat. The position of the current breach channel is expected to migrate south with this growth; providing access to the open ocean. As it develops the inlet is expected to be dominated by shifting shoals and breaking waves.

Problems and Needs

The formation of the new inlet has had enormous impacts on the Chatham Harbor and Pleasant Bay areas. The average tidal range has increased from about 3.5 feet at the fish pier to 4.5 feet. The Chatham shoreline, no longer protected, is directly exposed to ocean waves and storm surge from the Atlantic Ocean. The shoreline has experienced severe erosion resulting in the loss of much public and private property, including a number of homes. The new inlet has also caused a significantly increased shoaling problem for boaters as material eroded from the shoreline and Nauset Beach flows

unobstructed into Chatham Harbor and Pleasant Bay.

Vessels used to sail south, behind the cover of Nauset Beach, before entering the Atlantic Ocean. The virtual fusing of South Beach's northern most end to the mainland prevents most vessels, except the smallest ones, from taking the traditional route. Most of the fleet now uses the ever changing breach channel.

The breach exit allows the commercial fishermen shorter access to the Atlantic and shortens their overall sailing time by 45 minutes. Though shifting constantly, the throat or channel through the breach appears to be stabilizing with a controlling depth of -5 to -6 MLW. Waves continue to be hazardous in the breach and boaters must be cautious navigating this area. Average wave heights are around 2 to 4 feet and can reach heights greater than 10 feet during rough weather. At times when waves are this severe, all boating activity ceases. In summary, the existing tidal flows continue to provide some deep water (greater than 10 feet in some portions of Chatham Harbor) but navigation through the breach continues to be risky during even moderate seas; often forcing fishermen to use the tides to make safe passage.

Study of the Chatham Harbor area reveals three basic problems related to navigation:

1. Shoaling of the areas in and around Aunt Lydia's Cove.
2. The lack of safe, dependable access through the breach at all periods of the tidal cycle.
3. Increased sea swell at the Municipal Fish Pier.

The anchorage at Aunt Lydia's Cove and the access channel that passes south of Tern Island have seen a great increase in shoaling due to wave and current action produced by the new exposure to the ocean. The channel was dredged by the town in October 1989 to a depth of -7 MLW. By the summer of 1990 the channel had filled in so that depths averaged around -3 MLW. At its lowest, or critical shoaling point, depths were only -1 MLW. Though not as severe, shoaling is still a problem in the anchorage and at the pier as well.

Increased wave action with the help of higher tides, is causing the increased deposition of sand in the spar channel and cove. Waves from the south and east bring material from the breach and eroded material from the shore and move it in a northerly direction toward Aunt Lydia's cove and the surrounding area. This northerly transport results in large amounts of material being deposited on the tidal flats south of the cove and eventually in the cove itself. Increased wave and swell as well as ebb currents are also eroding the southern and eastern portions of Tern Island. Some of this eroded material is also deposited in the adjacent spar channel and anchorage area.

Despite the town's efforts to dredge, rapid shoaling has resulted in a lack of navigable water around Aunt Lydia's Cove which in turn has caused an increase in damages to boats attempting to enter the cove and for those who do not, lost working time and lower fish values. Many vessels have experienced hull, keel, propellor, and engine damage as a result of sailing their vessels over the shoals. Currently, the larger vessels have been

forced to moor outside of the cove in order to avoid these low water impacts. This is not only a dangerous situation due to the amount of vessels moored near the main channel and the swift currents in the area, but also the way many of these fishermen are now offloading their catch. Several deeper draft vessels moored outside the cove are now placing their catch on skiffs and bringing it to the pier. This double handling procedure is not only time consuming and costly but dangerous as well. The currents in the area are swift and and threaten to capsize skiffs. In early January 1991 such an incident took place. A fisherman fell from his skiff but was rescued by bystanders who witnessed the accident. It is not expected that this practice will continue in the future. Owners will relocate their vessels rather than offload in this manner. In addition, any fisherman who cannot offload his catch by 6 o'clock P.M. is forced to sell the catch the next day for lower prices.

The lack of navigable water in the cove area has also adversley impacted the operation of the Coast Guard vessels based there. The Coast Guard is currently unable to get out through the access or "spar" channel, just south of Tern Island, with its 44-foot boat for 2 hours on either side of low tide. These vessels have also experienced pump damages as a result of navigating through areas with insufficient depths. To avert this window of down time the Coast Guard purchased a $148,000 rigid hull inflatable boat. Powered by water jets, the new boat only requires 6 inches of water in which to operate. This boat is good for short rescue efforts but it is not built for heavy seas. The 44-foot vessel has since been relocated to a mooring outside the cove in order to continue to make this vessel available for serving the recreational and commercial boaters on the east coast of Cape Cod. This mooring practice is very difficult especially during the winter months.

Periodic maintenance of the spar channel area provides temporary access into the cove. However, the bar that exists in the breach area limits the work's effectiveness. Depths in the breach at its shoalest point appear to be stabilizing at -5 or -6 MLW; a condition very similar to the old inlet that existed prior to the breach. This depth limits the vessels with drafts greater than 4 feet to "playing the tides" to make safe passage possible. To risk going across the bar without 2 to 3 feet of underclearance could prove very costly as the boat risks grounding or even capsizing. Therefore, even with sufficient depth in the cove some fisherman still must work around the tides to go to and from the fishing grounds.

The third major problem being experienced is the increased wave attack on the Municipal Fish Pier. As a result of the cove being in close proximity to the breach, the Aunt Lydia's Cove area experiences heavy sea swell from the southeast. This action is especially severe during easterly and southeasterly storms.

This action has resulted in several effects. First, fishing vessels offloading are banged against the pier. This causes the vessels to incur chaffing damages. Bolts are being exposed in the piles and bulkhead which cause even more damage to the boats. The pier was rebuilt in 1983 and expected to last for 50 years. As a result of this increased damage to the pier, the life of the pier may be reduced by as much as 50 percent.

The needs in Chatham Harbor are twofold. The first is to introduce efficiencies so as to maintain the economic viability of the fishing fleet and responsiveness of the U.S. Coast Guard. Vessels must be able to get to the open ocean from a safe, dependable harbor through safe, dependable channels. Maintenance of such areas is a critical part of a project's viability. The second need to be addressed is the reduction of boat and pier damage caused by the increased swell action from the Atlantic Ocean.

Conditions if No Federal Action is Taken

If no Federal action is taken to improve navigation conditions in the area of Aunt Lydia's Cove the present condition and trends are expected to continue.

Until North Beach begins to migrate south, which is not expected to occur to any great degree over the next 50 years, the problems now experienced by the boaters who operate out of the cove will continue. Large amounts of eroded material will continue to shoal navigation areas in and around the cove. Even as North Beach moves, navigation conditions are not expected to be favorable. Shifting shoals and breaking waves have and will continue to make access to deep water of the ocean tenuous at best.

The town of Chatham is committed to the commercial fishing fleet and has a vested interest in the area, as evidenced by their development of the Chatham Municipal Fish Pier and dredging in recent years. However, the town and state have indicated that due to fiscal problems, current and near future, funds for this continued effort are not available. Aunt Lydia's Cove would become a completely tide dependent port. A without project depth of -1 MLW will be used in this analysis. Hydrographic data indicates this is the most likely condition without regular maintenance. Not all fishermen will be able to tolerate these conditions. A portion of the fleet may move to other harbors (as some have to Stage Harbor). However, this action is limited by available space and the new location's relationship to the fishing grounds.

Large swells impacting on the cove will continue to create offloading problems at the pier as boats are banged against pilings and bulkheads. As a result, damages will continue to the boats and pier. Accelerated maintenance of the fish pier will also be needed.

Planning Constraints and Objectives

Planning constraints are those parameters that limit the implementation of any proposed plan of improvement and serve to eliminate from consideration all those possibilities that offer no acceptable degree of satisfaction. These constraints can include natural conditions, economic factors, social and environmental considerations and legal restrictions. In the case of Aunt Lydia's Cove improvements, there were no major constraints known prior to the study that would inhibit the planning process.

The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning

requirements.

a. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective.

b. Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also to those that may not be marketed.

Several planning objectives were identified which specifically address the navigation problems and needs of the fishing fleet. These objectives would:

- Reduce the cost of commercial fishing operations for the Aunt Lydia's Cove fleet during the 1992-2042 period of analysis.

- Contribute to safer conditions for the commercial, recreational, and Coast Guard vessels based in Aunt Lydia's Cove during the 1992-2042 period of analysis.

- Reduce the effect of sea swells on the Chatham Municipal Fish Pier during the 1992-2042 period of analysis.

Local objectives for the project area include the continued management and success of Aunt Lydia's Cove as a base for commercial fishing. The town's recent efforts to keep a waterway open to the cove, continued maintenance of the Municipal Fish Pier, and the search for a long term solution to their problems, through a cost shared study with the U.S. Army Corps of Engineers, demonstrates their committment to these objectives.

PLAN FORMULATION

The consideration of the problems and needs within the study area led to the formulation of several improvement plans. These plans are designed to achieve the planning objectives, and are developed with regard to the planning objectives previously identified. State and local sponsor objectives are important considerations in the evaluation of alternative plans.

Plan Formulation Rationale

The formulation of plans for navigation improvements at Aunt Lydia's Cove and Chatham Harbor are based on a standard set of criteria. Improvement plans must be complete in that they provide and account for all necessary investments or other actions to ensure the realization of the planned effects. The plans must be effective so as to alleviate the specified problems and achieve the desired goals. The plans must be efficient, demonstrating a cost efficient means of alleviating the specified problems and realizing the specified opportunities. The plans must also be acceptable to state and local entities and the public and be compatible with existing laws, regulations, and public policies.

Each alternative is considered on the basis of its effective contribution to the planning objectives. Selection of a specific plan is based on technical, economic, and environmental criteria which permit the fair and objective appraisal of the impacts and feasibility of the solutions.

Technical criteria require that the optimum plan have the dimensions necessary to accommodate the expected user vessels and sufficient area to provide for maneuvering of boats and development or continued use of shore facilities. All plans must contribute to navigation efficiency and be complete within themselves.

Economic criteria require that the tangible benefits of the navigation improvement exceed the economic costs and that the scope of the project is such as to provide maximum net benefits.

Environmental criteria require that the selected plan incorporate measures to preserve and protect the environmental quality of the project area. This includes the identification of impacts to the natural and social resources of the area and minimization of those impacts that adversely affect the surrounding environment. It also includes the assessment of impacts that are incurred during the construction of the proposed navigation improvements and those activities attracted to the area after plan implementation.

Management Measures

A broad range of management measures can be identified and evaluated as the basis for formulating plans to solve the navigation problems in Aunt Lydia's Cove and Chatham Harbor. These mangement measures are categorized as either structural or non-structural.

Structural measures are those that involve the construction of features that would, to varying degrees, meet the previously mentioned planning

objectives developed for this study. This includes providing a channel and anchorage or some form of wave attenuating device. Non-structural measures are solutions which achieve the same objectives, but do so without resorting to structural improvements. An example of a non-structural measure is the transfer of vessels to neighboring ports with sufficient capacity to accommodate the additional commercial or recreational vessels.

Plans Developed to Address Identified Problems

Early in the study process a comprehensive list of possible solutions was developed by the study team. Ideas obtained as a result of meetings with the local sponsors and the concerned public were included. The list was then applied to an evaluative matrix to determine each solution's potential for further study. The matrix, shown below, uses engineering, environmental, economic, and public support criteria. Ratings for each criteria were conducted on a scale of A through C: A (3 points) being the most feasible or favorable and C (1 point) being the least.

DECISION MATRIX FOR POSSIBLE SOLUTIONS

PLAN	ENG.	ENVIR.	ECON.	SUPP.	SCORE
1. No Action (without project condition always part of report)					
2. Move Fleet To Other Ports	A	B	B	B	9
3. Channel South of Tern(Spar + Bay)	A	B	C	A	9
4. " " (including Breach)	A	B	C	A	9
5. Sand Bypass System	A	B	C	B	8
6. Jetty (off S.Jog)	B	B	B	B	8
7. Channel North of Tern(Spar + Bay)	A	C	C	B	7
8. Bulkhead or Wavefence (off S. Jog)	B	B	C	B	7
9. Channel North of Tern(Spar+Bay+ Breach)	B	C	C	B	6
10. Extensive breakwater/ bulkhead + dredging plan across Chatham Harbor	B	C	C	B	6

11. Underwater Scouring Struc.(i.e. wing type device that will not allow sand to settle out)	C	B	C	B	6
12. Beach Beams placed to meet both goals: wave surge/shoaling	C	B	B	C	6
13. Fill-In Breach	C	C	B	C	5
14. Stabilize Breach	C	C	C	B	5
15. Gov't pay locals for fishing losses	(cannot be done)				

With regard to channel options shown, the "spar" refers to the channel adjacent to Tern Island, the "bay" refers to the Chatham Harbor area, and the "breach" is self explanatory.

Based on information available at the time, the list gave a general idea of what solutions should be considered for more detailed study. Meetings were held with the local sponsor to select from this list the solutions that would be focussed on during the remainder of the study. A general consensus was reached that only items 1 through 9 would receive further study.

Description of Evaluated Plans

Based on the above evaluation six basic improvement plans were chosen for further study.

The no action alternative, or without project condition, is always part of the analysis. If no action is taken, the conditions that currently exist are expected to continue. The spar channel is expected to have a controlling depth of -1 MLW. This will result in higher operating expenses to the commercial fishing fleet. The deeper draft vessels, that cannot reach the cove at any tidal stage, will be forced to relocate to other harbors; resulting in increased steaming costs. Those vessels that stay at the cove will suffer delays and damages and be forced to access the cove at the higher tidal stages. The U.S. Coast Guard will continue to be greatly hampered in their efforts to operate a base at the cove. As a result of wave and swells entering the cove, damages to the pier and boats will also continue.

Non-Structural Alternatives

Plan A - This non-structural plan involves transferring the commercial fleet to other nearby harbors such as Stage Harbor, Provincetown, and Harwich Port. Further investigation determined that the transfer of a substantial number of vessels to Provincetown and Harwich Port was not possible. Both harbors are filled to capacity and are not capable of providing space for the

fleet.

Stage Harbor, the closest alternative port to Aunt Lydia's Cove, presents some possibilities. It is the site of an existing Federal project and supports a small trap-fishing fleet. There are four private commercial offloading piers in Stage Harbor. The harbor and its neighboring ponds are the town's primary source of shellfishing. In 1989 approximately $1,000,000 worth of shellfishing was harvested in the form of bay scallops, quahogs, softshell clams and mussels. There are currently over 340 registered mooring spaces in Stage Harbor, most of which are for recreational boats. The harbor is recreational in nature supporting four boatyards, two yacht clubs a sailing school and various other water activities.

Analysis of this plan required evaluation of the impact on the transferred fishing vessels, existing commercial space and facilities and the potential for and cost of expanding them. The benefit to be derived versus the costs of transferring the fleet is critical to the evaluation of this plan.

Structural Solutions

Plan B - This plan examined the feasibility of establishing and maintaining a Federal navigation channel and anchorage in the areas currently being used in Aunt Lydia's Cove, Chatham Harbor, and the breach.

The channel depth and width are determined as functions of vessel size and navigation conditions. Based on an average vessel size and using design regulations to account for wave, vessel squat, and safety clearance it was determined that the navigation channel should be -8 MLW and 100 feet wide. Four and six foot channel depths were also considered during the analysis. Two feet of additional depth is included in the portion of the channel that passes through the breach. This is done to account for the rougher wave and swell conditions in that area. Due to the expected high cost and uncertainty of maintaining a channel through the breach, alternatives of the channel plan that included both with and without the breach section were examined. A naturally deep, though meandering, channel seems to prevail through Chatham Harbor until the breach is reached where depths decrease to -6 MLW.

Due to exposed wave conditions even in the cove, anchorage depths were chosen to match the corresponding channel depth. Based on fleet statistics, the anchorage required was determined to be 7.5 acres.

Analysis of hydrographic surveys and other historic data revealed that maintenance of the channel and anchorage is critical to project implementation. It was determined that the heaviest shoaling (or critical shoaling) in the area of the spar channel is on the order of 6 inches per month. Storm activity can increase the shoaling rate drastically. As a result of these conditions it was determined that an average maintenance cycle of four months will be needed to achieve the desired project dimensions. Based on current operation and maintenance practices at New England Division, a reasonable Corps' maintenance cycle would be every three years. Though this frequency of dredging is not considered responsive to the needs of the project (due to shoaling the channel is filled in after a year), in terms of sensitivity, it is part of the analysis.

Once this need of continuous maintenance was established, several methods of accomplishing the work were analyzed. This included the purchase and stationing of a small hydraulic dredge at the cove and hiring a contractor with a hydraulic or mechanical dredge to clean out the shoaled areas several times a year.

Realizing the large amounts of material associated with maintaining the project, a long term strategy to handle the disposal needs was investigated. This included dedicating 6 acres of Tern Island for a confined disposal facility (CDF)(see Figure 7). The CDF would be periodically emptied and the material taken by tug and scow for disposal along the eroded shoreline south, near Lighthouse Beach. Some of the material could be used to nourish Tern Island, but over the long term this was not seen as a permanent disposal solution. Pumping the material directly to Nauset or Lighthouse beaches was investigated as was removing the material mechanically and having it taken by tug and barge directly to nearshore placement in the area of Lighthouse Beach. Beaches adjacent to Aunt Lydia's Cove were also considered for disposal but determined to be unsuitable due to the proximity and liklehood of this material quickly refilling the channel and anchorage.

Plan C - This plan is similar to Plan B, but in this case the spar channel would go north of Tern Island. The anchorage and disposal options would remain the same. Heavy shoaling is again expected to occur but in this case around the northern end of Tern Island as evidenced by sand accretion in this area. This critical shoaling area is expected to form at a rate of about half of what would occur in Plan B. An average eigth month maintenance cycle was seen as necessary for proper operation of this plan. A three year maintenance cycle was again considered as part of the analysis, though, as a result of the shoaling, the channel is expected to return effectively to its without project condition after two years.

Plan D - This plan examined the use of a rubblemound breakwater to reduce the amount of wave action at the Municipal Pier. This structure was determined to be the most effective method of dampening wave energy in the area. A pile/stoplog wavefence or a bulkhead jetty were also considered but determined to be not as effective and much more expensive. Structural measures such as dike stabilization of the tidal flats south of the cove or a floating tire breakwater would not be technically feasible in view of the moderate to heavy swells that impact the area.

Plan E - This plan involved combining the channel of Plan B, south of Tern Island, with a rubblemound jetty. The purpose of this plan is to eliminate pier and vessel damages and at the same time reduce the shoaling rate at the cove by deflecting some of the drifting sand. It is anticipated that this alternative will reduce shoaling to about half of what normally would take place in Plan B. Maintenance will be required on an average of every eigth months. This plan includes a revetment structure placed along the southern portion of Tern Island to prevent further erosion in that area.

Figures 5 thru 7 show the general location and features of Plans B thru E. For a more detailed description of each plan see Appendix 2.

CORPS OF ENGINEERS A B C D E F G H U. S. ARMY

1 2 3 4 5 6 7 8

N

CHATHAM

SHORE ROAD

CHATHAM LIGHT

ANDREW HARDING LN

HOLWAY STREET

SHORE ROAD

CLARLIN LANDING

ALTERNATE DISPOSAL SITE

100 FT

100 FT

AUNT LYDIA'S COVE

SHORE ROAD

ANCHORAGE

MANEUVER AREA

TERN ISLAND

ALTERNATE DISPOSAL SITE

NAVIGATION CHANNEL

100 FT.

PLAN-C
Channel North of Tern Island

PLAN-B
Channel South of Tern Island

SOUTH BEACH

NAUSET BEACH

GENERAL NOTES:

Topography is based on aerial photography dated February, 1991.

The approximate M.H.W. line is shown thus: ——

The approximate M.L.W. line is shown thus: .....

Areas of extreme shoaling are shown thus: (dashed)

Areas of potential dredging are shown thus: ——

PLAN
NOT TO SCALE

GRAPHIC SCALES
N. T. S.

SAFETY PAYS

NAVIGATION IMPROVEMENT STUDY
DETAILED PROJECT REPORT

AUNT LYDIAS COVE
& CHATHAM HARBOR
CHATHAM, MASSACHUSETTS

FIGURE 5
ALTERNATIVE CHANNEL IMPROVEMENTS

CORPS OF ENGINEERS

U. S. ARMY

A B C D E F G H

N255000 N254000

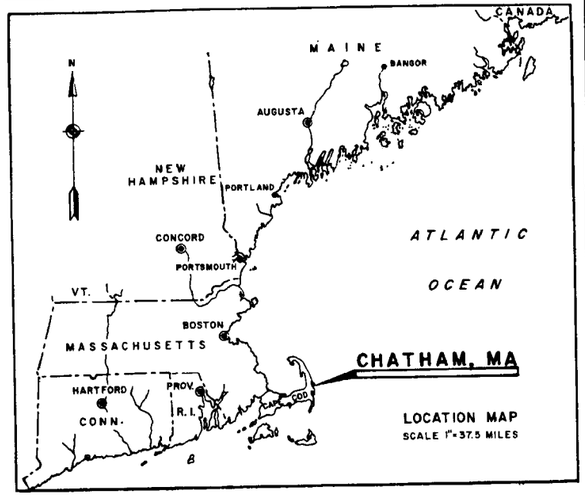
1 2 3 4 5 6 7 8

E 1024000

E 1023000

N253000

N255000 N254000



TERN ISLAND

NORTH (1989)

MEAN HIGH WATER LINE

AUNT LYDIA'S COVE

PLAN D

RUBBLEMOUND BREAKWATER
175' LONG CREST @ ELEV. + 8.0' M.L.W.

Flood
Ebb

7435C

MUNICIPAL FISH PIER

T.P. LITE POLE (89)

PLAN
SCALE 1"=100'

SAFETY PAYS

GRAPHIC SCALES
1"=37.5MI 25 0 25 50 75MI.
1"=100' 100 0 100' 200'

NAVIGATION IMPROVEMENT STUDY
DETAILED PROJECT REPORT

AUNT LYDIAS COVE
& CHATHAM HARBOR
CHATHAM, MASSACHUSETTS

FIGURE 6
PLAN D - BREAKWATER

AUNT LYDIA'S COVE, CHATHAM MA -

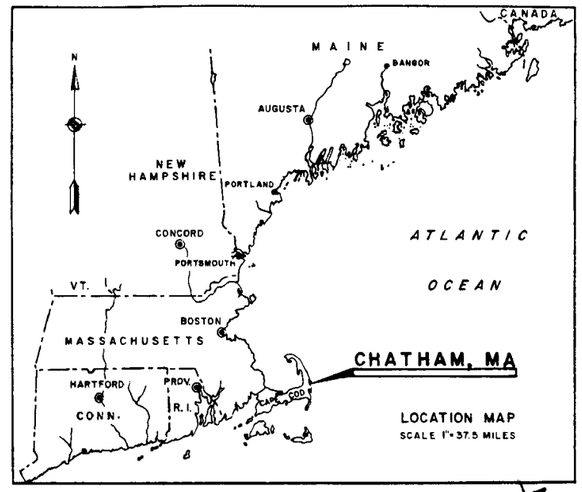
CORPS OF ENGINEERS — U. S. ARMY

A B C D E F G H

N255000 N254000

1 2 3 4 5 6 7 8

N



PLAN E

RUBBLEMOUND JETTY - ELEV. +8.0' M.L.W.
W/6' DEEP CHANNEL & ANCHORAGE

ADDITIONAL DISPOSAL AREA

℄ of Retaining DIKE

TERN ISLAND

ALTERNATE DISPOSAL
(CONFINED DISPOSAL FACILITY)

NORTH (1989)

MEAN HIGH WATER LINE

AUNT LYDIA'S COVE

600'

300'

7435C

Flood
Ebb

T.P. LITE POLE (89)

E 1026000

E 1023000

MATCH LINE FIG. 2-1A

PLAN
SCALE 1" = 100'

SAFETY PAYS

GRAPHIC SCALES
1"=37.5MI 25 0 25 50 75MI
1"=100' 100 0 100 200'

NAVIGATION IMPROVEMENT STUDY
DETAILED PROJECT REPORT

AUNT LYDIAS COVE
& CHATHAM HARBOR
CHATHAM, MASSACHUSETTS

FIGURE 7
PLAN E - JETTY

AUNT LYDIA'S COVE, CHATHAM MA -

COMPARISON OF IMPROVEMENT PLANS

As just described, six basic plans, including the no action alternative, were analyzed in the study. Several alternatives of each plan including the 4 and 6 foot alternatives were included as part of the analysis. Even though alternative depths are included, the 8-foot option is the proper design depth.

Cost analysis determined that establishing a channel through the breach was not economical and therefore safe, dependable access through the breach cannot be maintained throughout all tidal cycles. Costs for annually dredging the breach ($300,000 +) were found to outweigh the added benefit ($100,000 +) by three times. To save on detail, costs and benefits for those variations have been omitted from the Main Report but can be found in the supporting documentation.

The effects on the marine environment from each plan are similar but increase in scope as the dredging volume changes as shown in Table 1. The table shows quantities for channel improvements at 8 feet deep. Prior subsurface exploration in the area indicated that no channel or anchorage improvement would require rock removal.

Project Costs

Plan A, relocation of the commercial operation to Stage Harbor, was not found to be feasible. Economic analysis determined that transfer of the fleet would result in additional steaming costs to the fishing grounds. This additional cost is estimated to be $444,900. The total damages and delays benefit that would result from this plan is only $166,000. Based on this the benefit to cost ratio is 0.4. This does not even include the added costs of providing more anchorage space and shoreside facilities in Stage Harbor. Initial estimates indicate that another $1,000,000 in improved infrastructure would be needed to accommodate the fleet. This would only bring the benefit to cost ratio down further. The plan was dropped from further consideration. Further discussion of this plan can be found in Appendix 1 and 2.

Initial dredging of the channel and anchorage plans would be accomplished by a 10" hydraulic cutterhead dredge plant. Based on recent surveys dredging was not found to be necessary in the Chatham Harbor portion of the channel.

A detailed estimate of construction costs for the 8-foot depth of Plan B is shown in Table 2. Again, to avoid repetition a summary of the various initial construction costs for plans B and C can be found in Table 3. Costs for the construction of plans D and E can be found in tables 4 and 5. For purposes of this initial construction estimate, disposal of dredge material would be accomplished by pumping directly to Tern Island, although as described later, objections to this plan have been voiced by the island's owners. A contingency factor is included in each estimate to account for potential increases during the plans and specifications stage. At that time when the level of information regarding equipment, labor, and quantities increases this item will decrease. Costs for providing six steel can buoys are included in Plan C. The cost per buoy is $3,000. The U.S. Coast Guard will be responsible for placing and maintaining the buoys. Costs for placing

Table 1

Descrption of Detailed Plans

PLAN DESCRIPTION	PLAN B	PLAN C	PLAN D	PLAN E
Channel				
- Depth (ft below MLW)	8	8	--	8
- Length (ft)	7,500	13,500	--	7,500
- Width (ft)	100	100	--	100
Anchorage				
- Depth (ft below MLW)	8	8	--	8
- Area (acres)	7.5	7.5	--	7.5
Dredge Quantity (cy)				
- Ordinary Material	86,500	214,000	--	94,600
Rubblemound Structure				
- Length	--	--	175	900
- Height (ft above MLW)	--	--	8	8

Table 2

First Cost of Federal Improvement

Plan B - Channel South of Tern Island (Excluding Breach)

8-Foot Depth:	
Dredging Ordinary Material:	
Spar Channel & Anchorage 86,500cy @ 4.15/cy	$359,000
Contingencies	72,000
SUBTOTAL	$431,000
Preconstruction Engineering & Design	43,000
Construction Management	46,000
TOTAL FIRST COST	$520,000
Interest During Construction (3.5 months)	5,000
Aids to Navigation: 0 @ $3,000 ea	0
TOTAL INVESTMENT	$525,000

Table 3

First Cost of Federal Improvement

Summary of First Costs For Dredging Plans

Project Depth	PLAN B	PLAN C
4-Foot Depth	$267,000	$558,000
6-Foot Depth	$374,000	$804,000
8-Foot Depth	$525,000	$1,167,000

Table 4

First Cost of Federal Improvement

Plan D - Breakwater South of Tern Island

Rubble Mound Breakwater: 175 LF @ $1,800/LF	$315,000
Contingencies	63,000
SUBTOTAL	$378,000
Preconstruction Engineering & Design	56,000
Construction Management	40,000
TOTAL FIRST COST	$474,000
Interest During Construction (3 months)	4,000
TOTAL INVESTMENT	$478,000

Table 5

First Cost of Federal Improvement

Plan E - Jetty & Channel South of Tern Island

Rubble Mound Jetty: 900 LF @ $1,800/lf	$1,620,000
Stone Revetment: 1,000 LF @ $1,000/lf	1,000,000
Dredging Ordinary Material:	
Spar Channel & Anchorage 94,600cy @ 4.15/cy	$ 393,000
Contingencies	603,000
SUBTOTAL	$3,616,000
Preconstruction Engineering & Design	113,000
Construction Management	248,000
TOTAL FIRST COST	$3,977,000
Interest During Construction (12 months)	166,000
TOTAL INVESTMENT	$4,143,000

buoys south of Tern Island were omitted since they already exist.

As mentioned previously, maintenance of any navigation project in this highly dynamic environment is critical to project implementation. It is expected that any dredging plan proposed will need annual or several maintenance operations done per year. This is due to the formation of critical shoals that will develop soon after project construction. This shoaling will reduce the project's effective depths and again cause navigation delays and damages. Based on current information, an average maintenance cycle of four months for Plan B and eight months for Plans C and E will be needed. These estimates are based on average yearly shoaling rates. Storm activity could increase the needed maintenance frequency. To achieve the necessary maintenance, several methods were explored.

The first method examined the purchase of a portable 10" hydraulic cutterhead dredge as part of the project. The purchase price of the dredge is $350,000. The ownership cost is figured into the cost of doing the work. This method of maintaining a project was seen as the least costly method as it eliminates a contractor's costs of several mobilization/demobilization events per year and profit. A more detailed discussion of this maintenance option can be found in Appendix 2.

While maintenance costs are greatly reduced by purchasing a small hydraulic dredge and dedicating that dredge to the site on a continuous basis, the Federal government cannot participate financially as a dredge is not considered a General Navigation Feature. The information is presented, however, for information purposes in the event a non-Federal agency wished to pursue this option.

As a result of the town's recent disposal activities and the disposal of material from the initial construction of a Federal navigation project, it is anticipated that continual loose placement of material on Tern Island, in the future, will not be a long term disposal option. Therefore, a plan was developed to pump the dredged material to a six acre confined disposal facility (CDF) on Tern Island. The CDF provides a long term strategy for disposal. The six acre site would have a capacity of about 30,000 cubic yards. Once capacity is reached the material would be excavated, placed in a scow, towed by tug, and unloaded in the nearshore area (near Chatham Light) to help nourish the shoreline. The annual cost to build and operate the CDF is $110,000.

The total annual dredging maintenance figures for combining a stationed dredge with the CDF method of disposal is as follows:

Plan B - $282,000
Plan C - $281,000
Plan E - $223,000

It should be noted that recent coordination with the Audubon Society, owners of Tern Island, has revealed that the implementation of the CDF disposal scheme is doubtful. The Society has indicated that they are not in favor of devoting a portion of the island for continuous disposal. It would result in that area never being available as bird habitat. Audubon indicated that placement of the dredge spoil loosely on the island is more to their

liking. However, the Corps views this disposal method as severely limited for the long term goals of this navigation project. It is apparent that as a result of the town placing dredged material on the island, and certainly after the construction of a Federal project, the island's capacity for disposal in this way will soon be reached. The Audubon Society's goal is to accumulate enough material to recreate a sandy habitat to encourage tern nesting. Once that goal is reached, disposal activities will be terminated or severely limited.

Estimates, therefore, to have a contractor perform similar work, but in this case hydraulically pumping it to eroded shorelines near the Lighthouse Beach area, were also developed. The estimate for hydraulically pumping (by contractor) 7,000 cy of material 1.5 miles is approximately $205,000. Pumping 13,000 cy of material is estimated to cost $210,000. For Plan B (dredging every four months) this would translate into a total annual maintenance cost of $615,000. For Plan C and E (dredging every eight months) this would translate into a total annual maintenance cost of $315,000 and $308,000 respectively.

Another method investigated was to use a mechanical dredge and barge to conduct similar work. This option would be similar to the hydraulic method in that it would involve contracting for several dredgings per year. However in this case the dredged material would be loaded directly onto a barge and towed to erosion sites along the shore, 1.5 miles south of the cove. The estimate for mechanically dredging (by contractor) 7,000 cy of material and towing it 1.5 miles is $225,000. Mechanically removing 13,000 cy of material the same distance is estimated to cost $390,000. For Plan B this would translate into a total annual maintenance cost of $675,000. For Plan C and E this would translate into a total annual maintenance cost of $585,000 and $338,000 respectively.

In summary, as described above, one of the more critical elements of any navigation improvement project is the requirement for frequent maintenance dredging. Several methods of meeting these requirements were investigated including placement of a dredge at the site, use of nearby disposal areas as well as the more conventional use of a contractor with disposal on the eroded shoreline near the Lighthouse Beach area.

Economies can be achieved by purchasing and stationing a small dredge at the project site but Federal regulations prevent their financial participation. However, a non-Federal agency or group may wish to pursue this option.

Disposal of material at nearby Tern Island is not a viable long term disposal site and development of a confined disposal facility is opposed by the island's owners. Another site, Nauset Beach, is inconsistent with National Park Service policies.

Therefore, based on all information available, disposal of maintenance dredged material on the eroded shoreline toward Chatham Light is the likely long term disposal option. Use of a contractor furnished hydraulic dredge, pumping to this area, was used as the basis for annual costs shown in Table 8.

Table 6

Annual Charges of Detailed Plans

	PLAN B	PLAN C	PLAN D	PLAN E
Total Investment	$525,000	$1,167,000	$478,000	$4,413,000
Interest and Amortization (8 3/4 % for 50 years)	$ 47,000	*$134,000	$ 43,000	$368,000
Annual Maintenance	615,000	315,000	1,000	**318,000
Maintenance of Navigation Aids	0	3,000	--	0
TOTAL ANNUAL CHARGES	$662,000	$452,000	$ 44,000	$686,000

* Includes annualized cost of $30,000 for mitigating the loss of 5 acres of intertidal habitat.

** Includes an additional $10,000 for annual structures maintenance.

Dredging and Disposal Impacts

Dredging will cause short-term and long-term impacts. Short-term impacts are related to construction activity and include a temporary increase in turbidity and a temporary loss of benthic habitat. The significance and amount of benthic habitat disturbed is dependent on the plan chosen. Long-term impacts include the permanent replacement of one habitat for another (i.e. intertidal for subtidal).

Plans A and C are anticipated to cause the greatest impact to the environment. Moving the fleet to Stage Harbor would require provision of additional anchorage space. Due to current space restrictions this would result in impacts to intertidal and subtidal areas. Several acres of intertidal habitat would be replaced with subtidal if a channel north of Tern Island was established. It is estimated that 5 acres of intertidal habitat would be lost. Replacement of this loss through mitigation measures is estimated to cost $30,000 to $100,000 per acre and for purposes of cost estimating an average cost of $65,000 per acre was used. This results in an annual mitigation cost of $30,000.

Plans D and E would cause varying amounts of impact to the intertidal areas on which a rubblemound structure would be built. These areas would be permanently lost. If either of these plans were to be economically favorable additional analysis of their effect on the surrounding shoreline, current patterns, and water quality would need to be investigated.

Plan B, using the current channel layout, would have the least environmental impacts. This is due to the fact that dredging has been taking place in the area for over 50 years and rapid shoaling makes the existence of a significant benthic habitat in the spar channel unlikely.

With regard to disposal, the material to be dredged is clean sand and does not present a toxicological problem. As previously discussed, there are other constraints. The considered six acre CDF would cover a portion of Tern Island that is currently used for disposal and is not an active bird habitat. However, it would eliminate for future use, six acres of potential nesting area. Disposal in the nearshore or intertidal zone with any of the proposed methods will have some temporary impacts to the respective benthic communities as the material disperses under wave and current action.

A detailed description of the impacts of the various plans on the environment can be found in the Environmental Report.

Economic Benefits

The economic benefit of each plan analyzed is measured in terms of navigation dollars saved as a result of the project. In order to determine this amount the without project cost or "today's cost of doing business" for Aunt Lydia's Cove was calculated. The savings gained by each plan was then determined.

Four separate groups are incurring costs as a result of the shoaling and swell problems: the commercial fishing fleet, some recreational boaters, the town of Chatham, and the United States Coast Guard.

The commercial fishermen who operate out of Aunt Lydia's Cove have and continue to experience increased operating costs as a result of the changed conditions in Chatham Harbor. Shoaling in the Aunt Lydia's Cove and breach areas results in delay time which in turn causes higher labor and fuel costs. Due to the need to work around the tides and since many vessels must double handle their catch and supplies, the work day increases in length and so does the cost of doing business. Delays in getting the fish to the pier also results in the fish being purchased at "day-old" prices. The fishermen are also seeing higher operating costs due to increased damage to their vessels. Though boats try to wait for proper underkeel clearance, the unpredictability of certain shoal areas and the breach results in grounding damages. The increased wave energy in Chatham Harbor has also led to vessel chaffing damage while moored, and from banging against the pier during unloading.

The town of Chatham is also incurring certain costs due to the navigation problems at Aunt Lydia's Cove. The Municipal Fish Pier has been subjected to increased wear and tear as boats are banged against the structure during periods of moderate to heavy wave action. The cost of repairing pilings and fenders are costs born by the town.

The U.S. Coast Guard is also affected by the navigation conditions in and around Aunt Lydia's Cove. Repair and maintenance costs for the Coast Guard's 44-foot rescue vessel have increased as a result of the shoaling. They have had to purchase an inflatable lifecraft in order to provide the necessary response at all tidal stages. This vessel has a life expectancy of only 10 years, so without proper navigation depths this expense will need to be met again in the future.

Recreational boaters use the cove and several actually moor there. Even though many of these vessels enjoy shallow drafts and the flexibility of when they sail, it was determined that with navigation improvements a small increase in incidental recreation benefits will also occur.

A more detailed discussion and breakdown of each plan's economic benefits can be found in Appendix 1. Plan C includes an additional cost of $33,000 for steaming costs associated with this alternative. The cost is for the additional 1.3 miles needed to reach the fishing grounds and is added to the annual cost figure in Table 8. A summary of the annual project benefits is provided in Table 7. Again, the channel alternatives shown are based on the 8 foot design depth.

A summary of average annual benefits compared to average annual project costs for the various plans is shown in Table 8. Based on this information no alternative met the criteria for economic feasibility as each plan had a benefit to cost ratio of less than 1.0.

A sensitivity analysis was included as part of the study. As mentioned earlier in the report, a three year maintenance cycle was determined to be a reasonable frequency, considering funding and permitting, for the Corps of Engineers to maintain a navigation project. It was also determined that each of these alternative plans will require annual, if not more frequent, maintenance in order to achieve the desired benefits. Plan B shoals in so rapidly, thereby reducing its effective depth, that after a year without

Table 7

Annual Benefits of Detailed Plans

COMMERCIAL BENEFITS	PLAN B	PLAN C	PLAN D	PLAN E
Fishing Fleet				
- Reduction in Delays	$123,000	$123,000	$ --	$123,000
- Added Transp. Savings	161,000	161,000	--	161,000
- Damages Prevented	43,000	43,000	21,000	53,000
Town of Chatham				
- Damages to Pier	2,000	2,000	3,000	3,000
U.S. Coast Guard	21,000	21,000	--	21,000
RECREATIONAL BENEFITS	3,000	3,000	--	3,000
TOTAL ALL BENEFITS	$353,000	$353,000	$ 24,000	$364,000

Table 8

Economic Summary of Detailed Plans

	PLAN B	PLAN C	PLAN D	PLAN E
ANNUAL BENEFITS	$353,000	$353,000	$ 24,000	$364,000
ANNUAL COSTS	$662,000	*$485,000	$ 44,000	$686,000
BENEFIT TO COST RATIO	0.5	0.7	0.6	0.5
NET BENEFITS	—	—	—	—

* Annual cost includes $33,000 additional annual steaming costs to reach the fishing grounds

dredging the channel is back to the without project condition. Economic analysis revealed that considering a three year maintenance cycle for this channel results in project failure and a greatly reduced benefit. The option was not considered further.

However, a three year maintenance cycle for plans C and E may have merit. Based on the anticipated shoaling rates, both plans are calculated to have returned to their without project condition between year two and three. As a result, a substantial portion of benefits are considered available. In all cases however, the benefit to cost ratio falls short of unity. If a non-Federal agency or group were to pursue a project at the site they may wish to develop further this option.

Conclusions

The New England Division, Corps of Engineers, has reviewed and evaluated all pertinent data concerning the proposed plans for improving navigation at Aunt Lydia's Cove and Chatham Harbor. The Corps has also reviewed and evaluated the stated views of interested agencies and concerned public regarding the improvement plans. The possible consequences of each plan have been evaluated on the basis of engineering feasibility, environmental impact, and economic efficiency. Based upon this study no economically feasible solution was developed.

Relocation of the fleet to Stage Harbor, Plan A, was examined and found to be uneconomical due to the additional steaming costs that would be incurred by the fleet. Additional infrastructure costs were also briefly examined and found to be considerable. The benefit to cost ratio of this plan, even without those necessary capital improvements, is 0.4.

Channel alternatives, with and without a breach section, were included as part of the analysis. It was determined early in the study that to maintain a channel through such a dynamic area as the breach would not be feasible or economical. The study found the controlling depth in the breach to be around 6 feet at MLW. This is very similar to what existed at the old inlet five years ago, near Monomoy Island. It is understood that this depth is subject to change. However, recent history indicates that the breach has stabilized somewhat and depths tend to be shallow, not deep. Therefore navigation through the breach is expected to continue to be dependent on the tides. The benefit analysis reflects this limitation.

Plans B, C, and E investigated the feasibility of several channel configurations. Frequent dredging requirements for all plans necessitated high annual costs which when compared to available benefits yield a benefit to cost ratio less than unity.

Plan D, which featured a small breakwater, without channel improvements, was also found to lack economic justification.

RECOMMENDATION

It is recommended that no navigation improvement plan be implemented at Aunt Lydias Cove and Chatham Harbor, Chatham, Massachusetts at this time.

AUNT LYDIA'S COVE
CHATHAM, MASSACHUSETTS

(Section 107 - Navigation Improvement Study)

ENVIRONMENTAL REPORT

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September 1991

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FOREWORD

The following is an Environmental Report and not an Environmental Assessment. Due to the lack of an economically justified alternative, a benthic survey, 404 (b)(1) evaluation and compliance table were not completed.

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ENVIRONMENTAL REPORT

I. Introduction

The town of Chatham is located on the eastern side of Cape Cod. Cape Cod is a piece of land which juts from mainland Massachusetts separating the Atlantic Ocean to the southeast from Massachusetts Bay to the northwest. Chatham was protected by a barrier spit which stretched south from the town of Orleans. This spit, referred to as Nauset Beach, created a relatively stable inner shoreline and navigable harbor. An estuary is located landward of the spit which includes Chatham Harbor and Pleasant Bay (see Figure 1).

II. Purpose and Need for Project Study

On January 2, 1987, a severe northeaster caused a breach to occur in Nauset Beach, creating a new inlet. The barrier island located south of the inlet is now known as South Beach. The spit located north of the inlet is called Nauset Beach or North Beach. The formation of a new inlet in Nauset Beach has caused extensive shoaling and migration of sand in Chatham Harbor and along the shore of the mainland. As a result of the influx of sand into the harbor, fishermen have experienced difficulty navigating between Aunt Lydia's Cove and open sea. Several fishing boats have run aground causing damages to their vessels. Waves entering from the new inlet have caused damages to boats attempting to off-load at the town fish pier located in Aunt Lydia's Cove.

III. Alternatives

A. No Action Alternative

The most probable condition for the no action alternative is that the town of Chatham will continue to dredge the channel themselves until current funding runs out. To date, the town has dredged the spar channel twice, to seven and ten feet MLW, since the opening of the breach. Approximately 7,000 cubic yards of sandy material was dredged and disposed on Tern Island in October 1989. Dredging and disposal occurred from May to September 1991. About 39,000 cubic yards of material was disposed on Tern Island. Once appropriated funds are exhausted (within the next year or two) maintenance dredging of Aunt Lydia's Cove will probably discontinue. Unless other means can be secured, it will become strictly a tidal harbor.

B. Relocating the Fleet

This alternative would transfer the fleet to Stage Harbor (the closest alternative port with any space) in Chatham. Stage Harbor is located approximately three miles southwest of Chatham Harbor. Although this alternative would alleviate the delays and damages associated with Aunt Lydia's Cove, it would significantly increase the travel time to the fishing grounds. It currently takes a fishing vessel a minimum of 15 minutes to reach the fishing grounds from Aunt Lydia's Cove. The one-way trip took a minimum of 45 minutes before the breach. Traveling to the fishing grounds from Stage Harbor would take approximately two hours one-way.

Stage Harbor does not have enough anchorage area during the summer season for the fishing fleet. Some dredging would be required to provide year around additional anchorage area for the transferred vessels. Dock facilities and parking would also have to be improved upon. This alternative was determined to be economically infeasible based on the additional traveling time to the fishing grounds alone. The benefit-cost ratio is around 0.4.

C. Alternative Dredge and Structure Plans

Several dredging alternatives were considered which address the navigation problems at Aunt Lydia's Cove. The navigational problems are insufficient depth in the channel and exposure to wave action which result in damages to fishing vessels. These alternatives include:

Plan B - establish a Federal navigation anchorage and channel as currently laid out in Aunt Lydia's Cove and Chatham Harbor.
Plan C - relocate the channel north of Tern Island.
Plan D - build a breakwater structure to the south of the current channel to protect Aunt Lydia's Cove from wave action.
Plan E - combine Plan B with a rubblemound jetty south of Aunt Lydia's Cove.

D. Disposal Alternatives

Due to the large amount of annual dredging that would occur with each alternative, a long-term strategy for disposal of dredged material is needed. Several areas were considered for the disposal of dredged material. These include Tern Island, a flood tide shoal area southeast of the cove, the west side of North Beach, a containment area on the mainland south of the channel, and the Lighthouse Beach area.

It was determined that there was not sufficient space near the cove for a permanent containment facility. A hydraulic pipeline was also considered for disposal of dredged material from the channel on Nauset Beach. However, the pipeline would have to be submerged to accommodate boat traffic. This method was found to be unacceptable to the National Park Service (NPS) as dredging and disposal in a National Seashore is against NPS policy.

Another proposed disposal method is the construction of a confined disposal facility on Tern Island. The six acre site would contain roughly 30,000 cy of sand and would need to be emptied approximately every year or so. Dredged material would then be removed by mechanical means, placed in a scow, and towed south to an area for beach nourishment. This method is unacceptable to the Audubon Society (owners of the island), as it eliminates six acres of potential bird habitat.

Loose disposal of dredged material on Tern Island using a hydraulic pipeline dredge was also evaluated. Long term disposal with this method is not expected to occur. Disposal of dredged material from 1989-1993 will meet all habitat improvement needs; future requirements are unknown. Due to the uncertain availability of this method, it was also dropped from further consideration.

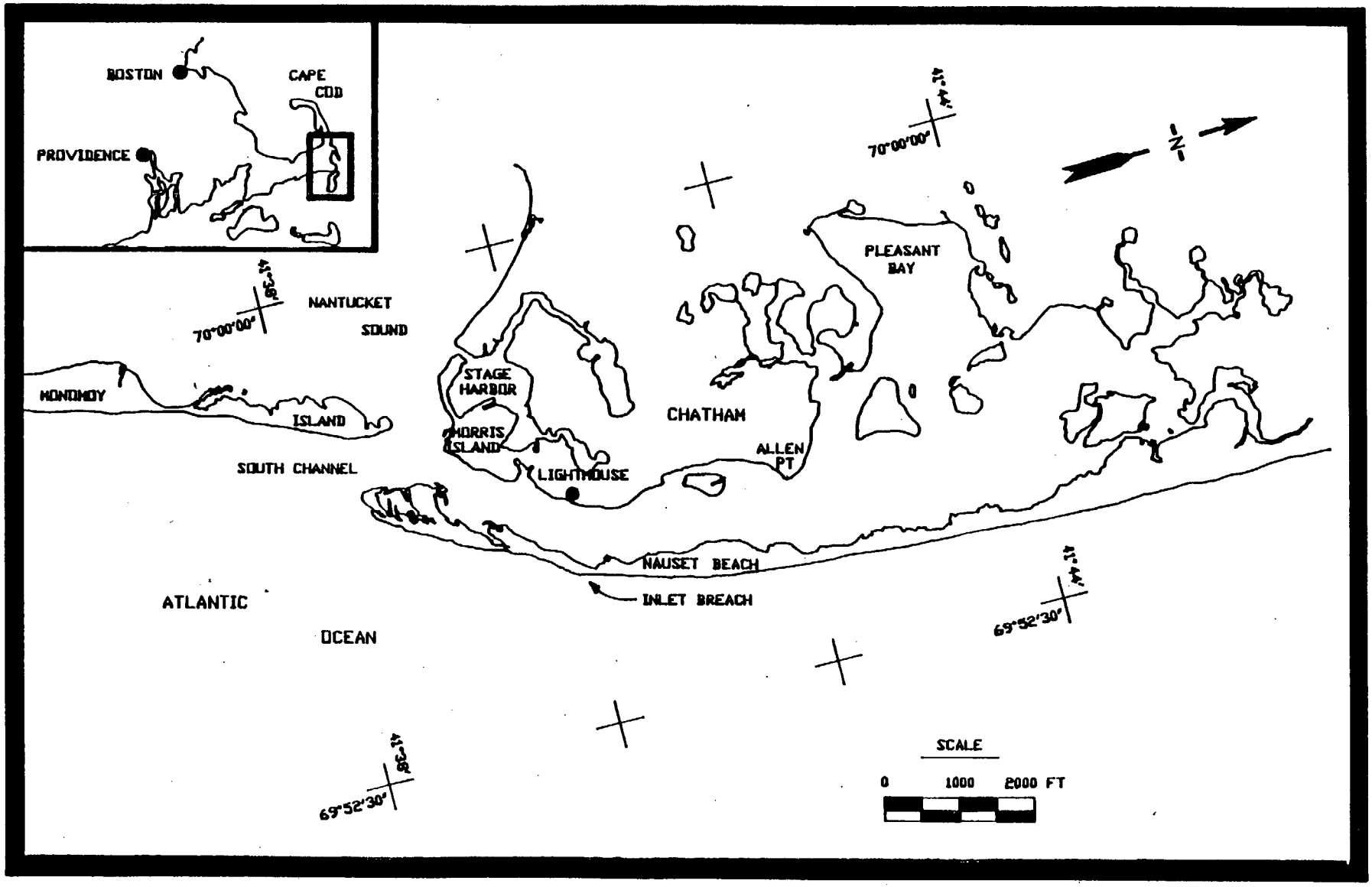


Figure 1. Location map showing Cape Cod, Chatham, and Nauset-Monomoy barrier system

The remaining option for disposal of dredged material is to remove the material either hydraulically or mechanically from the cove and place it in the areas around Lighthouse Beach. A hydraulic pipeline dredge could pump the material from the cove and transport it to the eroding shores as beach nourishment material approximately one to one and half miles away. An alternative method is to remove the material by mechanical means, place it in a scow and tow it south to Lighthouse Beach.

IV. Environmental Setting

A. Physical and Chemical Environment

1. History of Chatham Breach

The formation of a new inlet through Nauset Beach is not an unusual event. Since the early 1600's, the Monomoy-Nauset barrier spit complex has experienced several cycles of spit extension, inlet formation and migration, and island welding. The approximate 100 to 150-year cycle begins with the generation of Nauset Spit which grows to the south, paralleling the mainland shoreline of Chatham. The source of sand for spit growth is supplied from erosion of the Sandwich glacial moraine and outwash material of the Wellfleet, Eastham and Truro Plains.

The phase lag and difference in tidal range between the Atlantic Ocean and Pleasant Bay-Chatham Harbor becomes greater and greater as the spit extends beyond Morris Island. These conditions are conducive to the development of storm overwashes. If the width of the spit is narrow enough, the possibility exists for a storm surge to breach the spit and create an inlet.

Once the inlet is initiated, the difference in water level between the two sides of the spit helps to create a permanent channel. The new inlet then widens and migrates southward in response to the southerly longshore drift. The southern barrier island experiences erosion which results in the breakup and westward migration of the island towards the mainland. During this barrier island migration phase, it will extend across the former Chatham Harbor Inlet joining Monomoy and Morris Islands. After a period of 100 years or more, the northern barrier spit again extends to a position opposite Morris Island, recreating Chatham Harbor and conditions favorable for the breaching of a new inlet, which begins yet another cycle.

2. Topography and Geology

The surface geology of the outer portions of Cape Cod was developed during the retreat of the last stage of the Wisconsin ice sheet. The ice margin was held for several thousand years during which time a deposit of glacial debris (sand, gravel, clay, and boulders) accumulated, forming what is now Cape Cod. The ice sheets began to recede approximately 12,000 to 15,000 years ago. Sediments of outer Cape Cod were deposited as proglacial outwash plains over and around numerous ice blocks. The sand composing much of Nauset Spit and Monomoy Island is derived from Wellfleet, Eastham and Truro Plain deposits. These poorly sorted glacial deposits have been eroded by northeast waves and transported south by longshore currents to form the present-day barrier spit complex.

The mainland of Chatham opposite Nauset spit is characterized by cliffs, marshes and dunes bordered by low lying sandy beaches. Since the breach of Nauset Beach in January of 1987, the inlet has expanded to one and one-half miles wide. The redrafted north spit of South Beach has segmented becoming a part of the shoal complex, filling in and essentially blocking off the south harbor at low water. The formation of an inlet has had a significant effect on the mainland opposite Nauset Beach.

Ocean waves traversing the breach and striking the mainland have resulted in the loss of several homes. Erosion continues to effect the mainland. The direction of erosion along the Chatham shoreline is thought to be heading in a southerly direction from the approximate location of Hardings Lane. Lighthouse Beach continues to lose material. It is difficult to determine at this date whether or not this is an enduring or ephemeral change in the shoreline.

3. Water Quality and Tide Level/Range

Prior to the establishment of an inlet through Nauset Beach, circulation of Chatham Harbor and Pleasant Bay was limited to the South Channel inlet at the southern tip of Nauset Beach. Generally, a large tidal interchange takes place in the lower part of the estuary. The narrow opening of South Channel and the distance for tidal currents to reach Pleasant Bay caused circulation to be reduced in the upper reaches of Pleasant Bay. This is the direct result of the friction impacts that the shallow bay has on tidal movement.

Nutrient enrichment was a concern in some parts of the bay prior to the establishment of an inlet through Nauset Beach. Nutrient enrichment from septic tank wastewater, street runoff or feces from wildlife and domestic animals can result in eutrophication, plankton blooms and outbreaks of epiphytic plants (Sargent, 1989). Due to the shallowness of the bay and the availability of nutrients, organic sediments have built-up in the slack water area of the estuary. The combination of high water temperatures and low dissolved oxygen (DO) levels, caused by bacterial degradation of the nutrient rich benthic material, may have resulted in occasional summertime fish kills in the upper bay, as reported by a number of Orleans residents. The occurrence of these kills are thought to be isolated and infrequent since dissolved oxygen levels are, in general, relatively high, as reported in the 1967 Marine Fisheries Report. Measurements exhibit levels generally remaining above the class SA criteria for dissolved oxygen (6 mg/l).

Pleasant Bay showed very little difference in salinity concentrations throughout the entire estuary prior to the breach. The coastal waters adjacent to Pleasant Bay have high salinity concentrations of 30 parts per thousand (ppt) or greater. It is evident from detailed salinity measurements, made as part of a 1967 Marine Fisheries Report, that little dilution occurs in the bay since the volume of freshwater discharge (comprised mainly of outflow of several small streams, surface runoff and springs) is relatively small. Only localized areas near the mouth of the small streams show any freshwater influence at all.

Mean tide range prior to the breach is estimated at 2.5 feet at the upper portion of the bay, near Meetinghouse Pond. The mean tide range increases to 4.4 feet at the mouth of Chatham Harbor. The reduction in the range as one proceeds upstream is a function of the frictional impacts that the shallow bay has on tidal movement.

The most significant impact affecting water quality after the breach through Nauset Beach, is the reduction in length which the tidal prism must travel to reach the upper reaches of the bay. As a result of the reduced fractional length, the tidal range of the upper bay has increased. A Stevens mechanical tide gauge was installed at the Chatham fish pier in March, 1987 to measure tide height. The tide range at the Chatham fish pier has increased by one foot (0.3 meters). Tidal currents have increased as a result of the opening in Nauset Beach. Tidal currents in Chatham Inlet were reported as weak and variable (under 1 knot) for both ebb and flood tide. Maximum ebb currents measured in the breach exceed 2.7 knots (140 cm/s), while maximum flood currents exceed 1.9 knots (100 cm/s). On the average, maximum flood speed precedes the high water by approximately two hours, and the maximum ebb speed precedes the low water by about 12 hours and 45 minutes.

Ocean water, lower in temperature and higher in DO, mixes with the upper reaches of the estuary. The high DO water will reduce the occurrence of DO depletion and the lower temperature water will reduce the rate of bacterial action. Increased flushing will result in increased velocities which will remove organically rich benthic material. Its removal should reduce DO depletion through reduction of biological oxygen demand (BOD).

Since salinity was not reduced in the upper reaches of the bay before the breach, it is not expected to change very much after the breach. Cursory measurements of salinity were made on August 1, 1988 which showed that salinity concentrations were very nearly the same throughout the estuary (about 34 ppt for mean high tide conditions).

4. Sediment Quality

Sediment samples were collected on May 9, 1991 to determine grain size. Samples were collected from the proposed channel and anchorage alignments, Tern Island, the shoal area, and the beach adjacent to the lighthouse (see Figure 2). The sediment from the anchorage and proposed channel area consisted of grey to black fine sand with varying amounts of medium sand. Fines ranged from <1 to 24%. The highest values were found at the lower depths of locations A and B.

The shoal area consisted of medium to fine sand. Samples from Tern Island ranged from fine to medium sand. Sample K contained a small quantity of fines. The material from the beach adjacent to the lighthouse consisted of light brown medium to fine sand. Appendix I contains the grain size curves.

Sediment chemistry was also performed on samples A and B. The samples were found to have low levels of metals, PCBs, pesticides and PAHs. Table 1 lists the trace metals, total organic carbons (TOC), and PCBs. Appendix I contains a list of the remaining parameters tested. Table 2 displays the classification system for dredged material in Massachusetts.

B. Biological Environment

1. Aquatic Resources

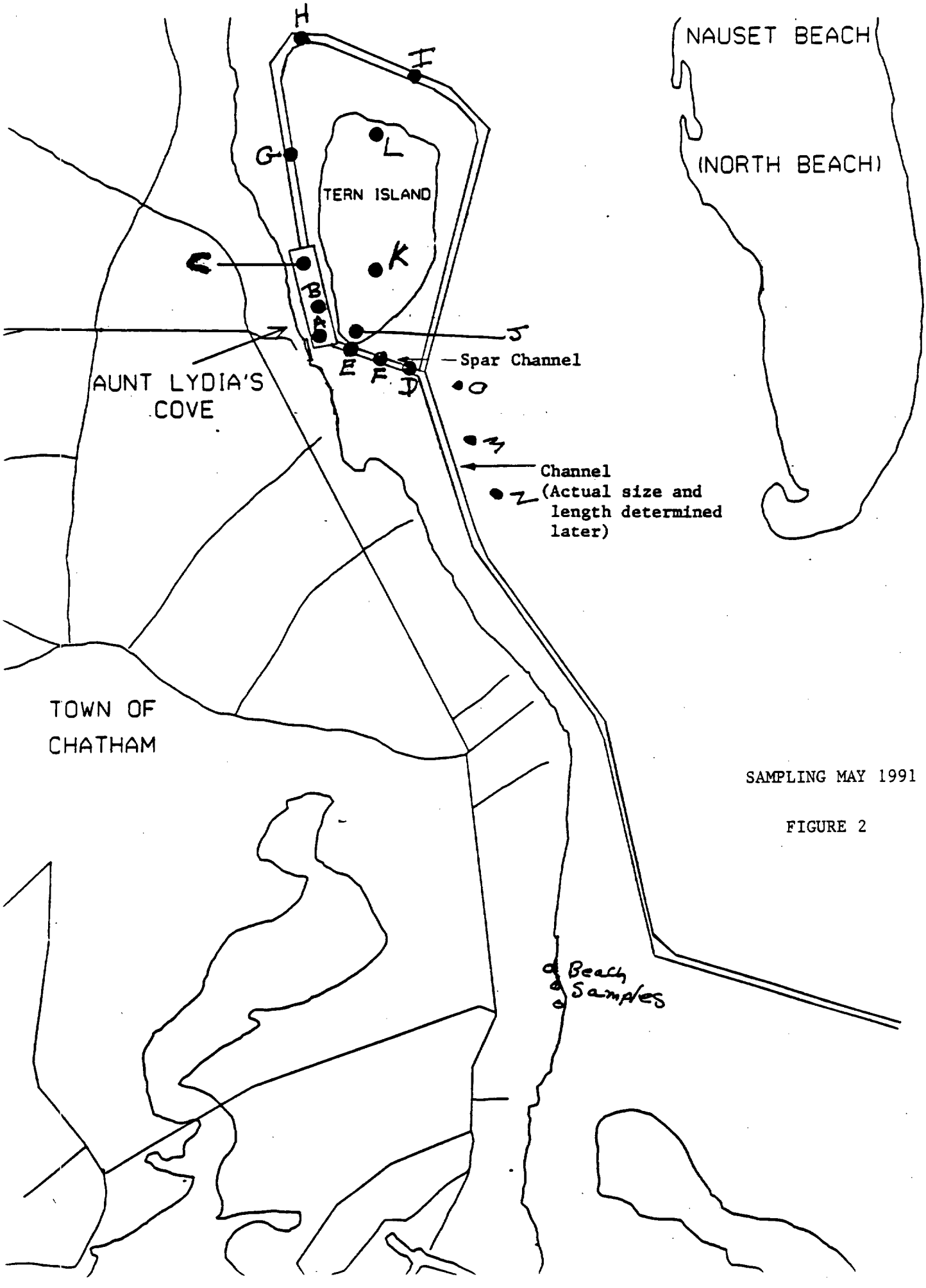
a. Eelgrass Beds

Seagrass beds represent habitat and detrital sources for numerous species. The dependence of the scallop's life cycle, for example, on eelgrass beds is well documented. Juvenile winter flounder and other commercial species exploit seagrass beds as nursery niches. The productivity of eelgrass is measurable as standing crop biomass. The changes in eelgrass densities throughout the Pleasant Bay system as a result of the breach will affect the harvest of numerous commercial species.

Areas located closest to the breach may experience lower eelgrass productivity since strong flushing will prohibit the detrital base from building at the sediment/water interface of the bed. The upper Pleasant Bay areas may not change at all. The most dramatic increases in eelgrass would be expected in the central Pleasant Bay. Recent remote sensing studies give a preliminary indication that the above scenario of increased eelgrass productivity has already occurred.

Remote sensing studies of eelgrass densities were conducted by Coastlines Project (William Sargent, 1991 - Environmental Appendix II). Aerial survey of eelgrass beds in 1982 was used as the baseline and used to compare aerial surveys taken in 1987, 1988, and 1990. The evaluation of aerial photographs in eastern Pleasant Bay indicate a direct loss of approximately 125 acres since the occurrence of the breach. These beds were covered by sand or scoured by waves and currents from the breach which can erode sediments, mature plants, and seeds (Thayer, G.W. et. al., 1984). This loss is restricted to the immediate (impact) area of the breach.

Eelgrass coverage from 1988 to 1990 increased to 33% in the area from Allen's Point to the southern end of the inlet. The increase shows that the eelgrass beds are recovering from high losses in the lower part of the bay where 88% of the losses occurred from the breach. However, 102 acres of newly established eelgrass beds, with less than 25% coverage, were scoured away by 1990. This represents a 98% loss of these newly established beds. The loss may be due to increasing tidal currents and altering channels, or removal by fishing equipment.



SAMPLING MAY 1991

FIGURE 2

TABLE 1

Aunt Lydia's Cove - Chatham
Sediment Chemistry

Parameters		Sample A	Sample B
Arsenic	(ppm)	2.3	2.9
Cadmium	(ppm)	0.15	0.11
Chromium	(ppm)	9.3	11.0
Copper	(ppm)	11.0	7.1
Lead	(ppm)	23.0	15.0
Mercury	(ppm)	< 0.03	< 0.03
Nickel	(ppm)	<17.0	<17.0
Zinc	(ppm)	37.0	33.0
t PCB's	(ppm)	0.013	< 0.0048
TOC	(%)	0.44	0.36

TABLE 2

Massachusetts Classification of
Dredged Material (Sasaki Assoc., 1983)

Parameter		Category One	Category Two	Category Three
Silt-Clay	(%)	< 60	60-90	> 90
Arsenic	(ppm)	< 10	10-20	> 20
Cadmium	(ppm)	< 5	5-10	> 10
Chromium	(ppm)	<100	100-300	>300
Copper	(ppm)	<200	200-400	>400
Lead	(ppm)	<100	100-200	>200
Mercury	(ppm)	<0.5	0.5-1.5	>1.5
Nickel	(ppm)	< 50	50-100	>100
Vanadium	(ppm)	< 75	75-125	>125
Zinc	(ppm)	<200	200-400	>400
PCB's	(ppm)	<0.5	0.5-1.0	>1.0

b. Benthic Fauna

A field trip to Chatham Harbor was taken in May to characterize the benthic community in the project area. Benthic samples were collected but not analyzed (since the project's economic benefits were low). Large patches of eelgrass were noted in the harbor, especially north of Tern Island. Clumps of blue mussels were associated with the eelgrass, and with the Spartina sp. fringing the coast opposite Tern Island. Blue mussels were also abundant in many other locations throughout the harbor.

c. Commercial Shellfish (Molluscan and Crustacean)

The major shellfish resources harvested in Pleasant Bay include scallops, clams, mussels, whelks and potentially oysters. Commercial fisheries are primarily quahog, Mercenaria mercenaria; softshell clams, Mya arenaria; scallop Aequipecten irradians or Chlamys islandica and blue mussel, Mytilus edulis. Some commercial landings of surf clams, Spisula solidissima, and Eastern oyster, Crassostrea virginica are also recorded. American lobster, Homarus americanus are potted for throughout the Bay. An additional valuable commercial (crustacean) shellfish is the horseshoe crab, Limulus polyphemus which is captured for extraction of fluids used for medical testing. Fisheries also exist for razor clam, Ensis spp. and whelks, Busycon spp. The Chatham Harbor and Pleasant Bay shellfish harvest is summarized in statistical records kept by the Chatham shellfish department. Table 3 is a summary of the annual landings through 1990.

Table 3
Shellfish Landings totalled for Chatham Harbor and Pleasant Bay
(Chatham Shellfish Department Annual Records)
All values in bushels

Year	Quahog	Softshell Clams	Scallops	Surf Clam	Oyster	Mussels
1990	---	---	---	---	---	110,000
1989	---	---	1,700	---	---	30,000
1988	700*	40	---	---	---	30
1987	336	443	---	13	---	95,364
1986	344	566	299	---	---	91,096
1985	296	735	2,139	---	9	568
1983	159	579	27,987	---	2	23,000
1982	146	665	39,351	---	2	86

* Seed Transplant Program

Data from the Coastlines Project also show an increase of 344 acres of new eelgrass and blue mussel beds from the southern end of the inlet, where South Beach welds to the mainland, to the break in Monomoy Island. This is a 1885% increase in eelgrass and mussel beds since 1982 and almost as much since 1988. The gain in eelgrass and mussel beds is the result of the nearly complete welding of South Beach to the mainland. This process has created a protected area, the equivalent of a new bay, that is rapidly

filling in with eelgrass and mussels. The increase in acres of eelgrass and mussels can represent an associated potential for fisheries enhancement. Both direct harvest potential and indirect benefits from increased commercial fisheries nursery areas will be realized from the increased eelgrass densities in Pleasant Bay and Chatham Harbor. The proliferation seems to have compensated for the loss of eelgrass from the breach and to display a trend towards increased growth in the future.

One of the most unique fisheries in the Pleasant Bay area is the commercial harvest of horseshoe crabs. This species is captured live for extraction of its body fluid. The fluid is used as a medical test media. Approximately $35,000 worth of crabs have been harvested annually from the Bay over the past few years. These organisms have been returned alive to perpetuate the harvest. The breach and its environmental changes have not directly impacted this harvest.

Other Shellfish

Additional landings of surf clams, Spisula solidissima, oysters, Crassostrea virginica, whelks, Busycon spp, and razor clams Ensis spp. are reported throughout the study area. Lobsters, Homarus americanus are potted for throughout the Bay. These commercial and recreational harvests are generally in the range of tens of bushels per year or less. They are primarily unchanged by the breach impacts.

The impact of the breach on shellfish populations are primarily exhibited by changes in scallop habitat (eelgrass bed densities), and the direct burial of clam and mussel beds. The loss of shellfish beds is a quantifiable negative impact, measurable in harvest landings. The expansion of eelgrass beds is ecologically measurable by density, but due to the variability in annual scallop harvests, attributable to other extrinsic factors, the breach impact on scallop harvest is not quantifiable in terms of shellfish (bushel) yields.

d. Finfish

Pleasant Bay is the second largest estuary in the State and is a noted sportfishing area. Because of its warm waters and suitable spawning and nursery habitat, many species of fish spend most or part of their lives in the estuary. In particular, it is noted to be a major spawning and nursery area for alewife Alosa pseudoharengus, winter flounder Pseudopleuronectes americanus, and American eel Anguilla rostrata. Due to the lack of freshwater pond tributaries, the herring fishery is not as strong as one would expect for such a large estuary. The commercial eel fishery of Pleasant Bay is significant and is carried on during the summer months when they are potted using crushed female horseshoe crab and dead fish as bait (ACEC, 1986).

Winter flounder move into the upper portions of the bay during the fall and remain in this area until spawning is completed, usually by mid-March (ACEC, 1986). The young-of-the-year flounder will generally remain in the immediate area where they hatched. In late spring the flounder will move from the shallow waters of the upper estuary to the

deeper cooler waters of the lower bay and adjacent coast in late spring. The absence of flounder will be noted when surface water reaches 70 degrees Fahrenheit as the fish migrate from the upper bay towards the inlet.

Over thirty-five varieties of fish inhabit Pleasant Bay at one time or another during part of their lives (ACEC, 1986). In early spring, eelgrass beds and marsh tidal creeks consist of year-round fish residents, such as tiny sticklebacks Apeltes quadracus and killifishes Fundulus sp., that emerge from an overwintering state to feed actively in preparation for spawning in mid- and late spring and early summer (Whitlatch, 1982). Pleasant Bay is one of the most productive sportfishing areas on the east coast of the United States because of the migratory sportfish which include the striped bass Morone saxatilis and bluefish Pomatomus saltatrix which are caught from May to November (ACEC, 1986). This is due primarily to the abundance of baitfish (such as silversides Menidia menidia, sand lance Ammodytes americanus, and juveniles of other fish species) in the bay. Atlantic codfish Gadus morhua occur in the lower bay during the winter months. Other popular predatory fish include pollock Pollachius virens, tautog Tautog onitis, scup Stenotomus chrysops, and tomcod Microgadus tomcod. White perch Morone americana frequent upper tributaries to the bay during warmer months.

2. Terrestrial Resources

Low marsh is almost monotypically vegetated by salt marsh cordgrass Spartina alterniflora. High marsh is most often dominated by one or a combination of the following species; salt meadow grass S. patens, spike grass Distichlis spicata, and black grass Juncus gerardi.

The mainland of Chatham is composed of glacial till material and is occupied by a developed residential community. As a result, most of the flora found along the mainland of Chatham is typical of residential areas and plant species found inland on Cape Cod.

Several animals are able to inhabit the harsh sand dune/barrier beach environment. Species include ants, sand dune locusts, pale colored wolf spiders, mice Microtus pennsylvanicus, Fowler's toads Bufo woodhousei fowleri, hog-nosed Heterodon platyrhinos and garter snakes Thamnophis sirtalis sirtalis (Godfrey et. al., 1978). Because of the limited cover on South Beach, only meadow voles Microtus pennsylvanicus, and maybe fox Vulpes vulpes and skunks Mephitis mephitis, would be found (Prescott, 1989). These animals eat gulls and dead animals that wash-up on the beach. Additional animals found on North Beach are long-tail weasels Mustela frenata, short-tail Blarina brevicauda and masked shrews Sorex cinereus, and deer Odocoileus virginianus (Prescott, 1989).

Typical fauna expected to inhabit the mainland of Chatham near the shore are muskrat Ondatra zibethicus, jumping mice Zapus hudsonius, red-backed voles Clethrionomys gapperi, squirrels Spermophilus sp., eastern cottontail Sylvilagus floridanus, moles, opossum Didelphis virginiana, and bats Myotis sp. which fly over the marshes eating insects (Prescott, 1989). Rats Rattus sp., and meadow voles use Tern Island as habitat. The northern diamondback terrapin Malaclemys terrapin terrapin can be found in Pleasant Bay to Tern Island.

Marine mammals which use the study area on a seasonal basis are the harbor seal Phoca vitulina and gray seal Halichoerus grypus. These animals use the sand bars of Chatham Harbor and South Channel in the winter (between October and May) as haul out areas. Humpback whales Megaptera novaeangliae and finback whales Balaenoptera physalus migrate offshore through the area in the fall. White-sided dolphins Lagenorhynchus acutus can travel through the study area anytime (Prescott, 1989).

A number of bird species are known to inhabit the barrier system. These species include horned larks, marsh hawks, kestrel, merlin, piping plover, least terns, short-eared owl, loggerhead shrike, and arctic tern (Godfrey et. al., 1978). Northern Harriers nest on South Beach; Short-eared owls nest on Monomoy Island and could potentially nest on South Beach island or North Beach. Other birds which are of particular note are the bald eagle and peregrine falcon. The bald eagle is a rare visitor to the barrier dunes. The migrant peregrine falcon is transient and rare, but frequently hunts shorebirds along Nauset spit (esp. the landward side) from August to November. Additional abundant and common birds species of Pleasant Bay (ACEC, 1986) include the great cormorant and double-crested cormorant, brant, Canada goose, black duck, mallard, common eider, common goldeneye, bufflehead, red-breasted merganser, black-bellied plover, semipalmated sandpiper, laughing gull, herring gull, great black-backed gull, common tern, morning dove, rock dove, downey woodpecker, northern flicker, horned lark, tree swallow, blue jay, black-capped chickadee, American robin, house sparrow, American goldfinch, House finch, yellow-rumped warbler, chipping sparrow, white-throated sparrow, dark-eyed junco, and common grackle.

C. Endangered, Threatened and Rare Species

The project area provides habitat for a variety of endangered, threatened and rare species. These species include the Piping Plover Charadrius melodus, a Federal and State listed threatened species, as well as two State listed Species of Special Concern; the Least Tern Sterna antillarum and the Common Tern Sterna hirundo. Piping Plovers and Least Terns nest on wide open beaches. Potential nesting and feeding sites for all of the above species exists throughout the project area.

Endangered marine species known to inhabit the Great South Channel off Chatham are the humpback whale Megaptera novaeangliae, right whale Eubalaena glacialis, and fin whale Balaenoptera physalus. The Kemp's ridley sea turtle Lepidochelys kempii is also found in the near shore waters of Massachusetts from mid-summer to late fall. The endangered ridley turtle uses the nearshore waters of southern New England as juvenile summer feeding grounds. They appear to prefer the estuarine areas where small green crabs and mussels are found. The leatherback turtle Dermochelys coriacea forage in open bay waters in search of jellyfish. These two turtle species plus the green sea turtle Chelonia mydas have been sighted in Nantucket Sound, Cape Cod Bay, and in offshore Atlantic waters. To date there have been no reports of sightings and/or strandings of any of these turtle species in the Aunt Lydia's Cove region.

D. Historical and Archaeological Resources

According to the site files at the Massachusetts Historical Commission, there are 48 known prehistoric sites in the vicinity of the proposed project area. One study has identified 72 prehistoric sites between Stage Harbor and Little Pleasant Bay (Dunford, 1989). Site types include burials, shell middens, small campsites or workstations and larger habitation sites. This area comprised a significant resource base for human populations for at least the last 4,000 years. Earlier sites of human occupation were no doubt present, but have been destroyed by past sea level rise and coastal erosion.

William Nickerson purchased land from the inhabitants of the Chatham area, the Monomoyick natives, in 1656. He and his family were the first of European descent, to settle in the area in 1665. Due to the isolation of the area and a title dispute over the land, the town developed very slowly. Agriculture was the mainstay of the town's economy until the early 1700's when fishing and coastal trading became Chatham's main occupations. The Revolutionary War nearly destroyed the town's maritime economy, however, Chatham rebuilt its fishing and packet ship fleets. By the early 19th century, the town was ahead of the other communities in the handling of freight. With the opening of the railroad to Chatham in 1887, the town began to develop as a summer resort. Fishing and tourism are currently the town's major industries.

The unstable nature of Nauset Beach historically has had an effect on Chatham's economy. In the 1830's, Chatham's fishing fleet was cut in half since vessels could not reach Stage Harbor due to the shifting sand bars. The breach opened in the 1850's and the fishing industry again prospered The same process repeated itself in the early 1920's. Two lighthouses fell victim to the erosion of the shore; one in 1840 and the second in 1877. Each time the lighthouses were constructed further inland. The current lighthouse in use was constructed in c. 1880.

Aunt Lydia's cove was first utilized as a harbor in the 1940's. Since that time, the channel and the anchorage have been kept open by periodic dredging. Prior to this, according to a 1910 map (n.a.), Tern Island was a peninsula attached to the mainland, with a breach of Nauset Beach directly opposite this peninsula. Historically, the peninsula was present at least as early as 1847.

There are at least 55 historic shipwrecks recorded off Chatham. Their locations are unknown.

E. Socioeconomic Environment

Chatham is a residential town with a small labor force. Its principal industries are tourism and commercial fishing (Poggie and Pollnac, 1981). Aunt Lydia's Cove (town pier) and Stage Harbor are the two largest and important commercial fisheries harbors in Chatham. The majority of the fishing boats moor at the town pier (Poogie and Pollnac, 1981). The town pier has two facilities for unloading and packing fish. There exists bait and gear shanties, a retail fish market, a tourist platform, and coin-

operated binoculars, and an unloading dock for tractor trailers. In short, the town pier represents the center of commercial fishing activity in Chatham.

The importance of the fishing industry to Chatham's economy was documented in a survey conducted in 1977 (Dewar, et.al., 1978). Fishing and fish-related firms were responsible for at least 558 jobs. Seventeen percent of this labor force lived in Chatham. Fishermen, fish dealers, suppliers of goods and services to the fishing industry, and town government provided jobs related to this industry.

Originally designed to accommodate 40 boats, the pier now has over 100 landing permits assigned. Mooring space is limited. The boats are crowded from the lack of space.

Compared to standards set by other fishing communities, Chatham fishermen are well educated (Poogie and Pollnac, 1981). Nearly every fisherman has finished high school, and half of them have some college experience. None of the fishermen however, have had any special training in fishing.

V. Environmental Impacts

A. Physical and Chemical Impacts

Four shoals have been identified on the flood-tidal delta complex of the breach. Two shoals are located in Pleasant Bay on the the northern side of the inlet. These two shoals have frequently changed shape and present navigational hazards for boats attempting to navigate from or to the town fish pier. Two additional shoals have been identified on the south side of the inlet in Chatham Harbor. The south flood-tidal delta and south sand flat are growing in area and shoaling as sediment is being deposited on each tidal cycle. The south delta shoal features have virtually closed off this passage to the south to all but shallow-draft boats at high tide. The navigation channel to the town fish pier would require constant maintenance as the sand is carried into Pleasant Bay.

It is anticipated that minimal physical or chemical impacts would occur from dredging the currently used channel. Since most of the material causing the shoals is sand eroded from Nauset Beach, little chemical or physical impacts would be expected. Turbidity caused from dredging would be of a short duration and settle quickly once construction was complete. Aunt Lydia's Cove has been dredged twice since the breach occurred with no significant environmental impacts.

Plan C, dredging a channel north of Tern Island would also have minimal turbidity and chemical impacts. Based on the sediment chemistry of the area and the large grain size of the sediment in the area, no significant physical or chemical changes are expected from dredging activities in this area. Effects due to changes in hydrology are not known.

Plan E, the construction of a jetty to reduce wave energy at the Fish Pier and shoaling in the spar channel, would cause a change in current patterns in the adjacent area. The reduction in wave energy could cause waves carrying sediment to drop their load resulting in shoaling adjacent to the structure and possible erosion of areas that would normally receive this material. The extent of accretion and erosion resulting from construction of this structure is undetermined. Plan D, the construction of breakwater south of the spar channel, is not expected to significantly alter the current patterns in this area due to the small size of the proposed structure.

Changes to salinity, temperature, dissolved oxygen (DO), or other physical parameters in Chatham Harbor and Pleasant Bay, from dredging, would be negligible. This estuary has already had significant impacts from the creation of an inlet through Nauset Beach. Salinity prior to the breach was approximately 30 ppt. This has increased to 34 ppt after the initiation of the breach. Temperature and dissolved oxygen also closely resemble ocean temperature and DO. The creation of a navigation channel would not have a significant effect on these parameters.

Disposal should occur at sites that are eroding or have minimal biological resources and would not cause significant shoaling of the navigation channel. One of the proposed disposal sites is Lighthouse Beach opposite the breach on the mainland. Much of the area directly opposite the breach is covered by revetment. Physical impacts associated with disposal at this site is to determine where the ultimate destination of this material would occur. The direction of littoral drift in the erosive area opposite the breach is to the south. The disposal of dredged material in this area would only temporarily slow the erosion of this area. This is due to the small amounts of material that would be placed near the shore with each maintenance event.

Disposal of dredged material at the shoal area, just southeast of the cove, is too close to the project area. Wave action and currents would carry much of this material back towards the cove or impact navigation outside the cove.

Disposal of material above MHW would avoid turbidity impacts to Chatham Harbor. Loose disposal of dredged material on Tern Island would occur above mean high water. Material would be piped from a hydraulic dredge to Tern Island. The capacity of Tern Island is estimated to be only three years, or less, at which point the desired bird habitat would be created. After this time, material would need to be removed to make room for more material or an alternative disposal site would be used.

B. Biological Impacts

Impacts of turbidity on eelgrass would depend on the location of the dredging area and direction of currents at the time the proposed navigation channel is dredged. It is expected that eelgrass can tolerate some deposition of sand but not large quantities of sediment which could bury substantial portions of existing meadows (Thayer, G.W., et.al., 1984).

The level of impact from dredging is dependent on the alternative choosen. Dredging of the spar channel, Plan B, would have minimal impact as this area is currently being maintained. A significant biological community is not expected to inhabit the spar channel. Dredging of a navigation channel north of Tern Island, Plan C, would remove approximately five to seven acres of intertidal habitat. Mitigation to replace this lost habitat should occur in Chatham Harbor if possible. Otherwise other alternative sites would have to be investigated. The costs associated with this type of mitigation is estimated to occur somewhere between $30,000 to $100,000 per acre. These cost estimates do not include the cost of real estate, soil reworking, or monitoring.

The construction of a breakwater or jetty will permanently displace the benthic community located in the footprint of the structure. Although a hard structure will permanantly displace a sandy benthic community, the structure could provide support for other kinds of benthos, such as blue mussels. Potential scouring and accreation associated with a breakwater and jetty may initially alter the benthic community in the area. It is anticipated that an equilibrium would be reached and a benthic community established in the area of the breakwater or jetty.

Impacts would also most likely be dependent on the timing of maintenance dredging. Dredging which occurs regularly (several times a year) might not provide adequate habitat for the establishment of eelgrass beds or shellfish communities so direct impacts to these biological resources would be minimal. If dredging occurs at lengthier intervals, once every two or more years, than impacts to the benthic community would be greater.

Potential impacts to the proposed disposal sites is discussed for each site. Disposal of dredged material on Tern Island above MHW would have minimal impacts on benthos in adjacent areas. Disposal of dredged material in the winter may have an impact on meadow voles which burrow into the dune during this time of the year. Tern Island supports a salt marsh at the north end of the island. These areas would be avoided during the disposal operation. The use of sandy material on Tern Island may encourage nesting of piping plovers and least terns. The area would need to be monitored for nesting activity. Dredging and/or disposal activities will be timed to avoid nesting activities for these birds. Due to the anticipated volumes of dredged material and limitations of Tern Island because of its bird habitat potential, long term disposal on Tern Island, either through loose placement or CDF, is not probable.

No significant impacts to biological resources are expected from the placement of sand along the mainland of Chatham due to the highly dynamic and erosive nature of the area. This may be substantiated by the results of the benthic data collected for this site. Some indirect impacts might occur from the transport of disposal material away from the disposal site. However, these impacts are not expected to increase significantly beyond the natural condition occurring now.

The flood tide shoal area located southeast of the cove supports an intertidal sandy benthic community. Any disposal in this area would occur to the south and west of the shoal to avoid impacts to the eelgrass bed located in the northeast corner of the shoal.

Impacts to intertidal habitat under Plan C make this plan environmentally sensitive. Mitigation would be required if this plan were to go forward. Plan E has the potential to create additional erosional and accreation problems with the construction of a jetty. Construction of a breakwater is not expected to create significant changes in current patterns. Plan B is the plan currently used by the town of Chatham to maintain the navigation channel at the cove. Continuous dredging in this area prevents the establishment of a significant benthic community. Although continuous dredging in this area would alter the natural tendency of Tern Island to attach to the mainland, it can provide a benefit to Tern Island by minimizing the number of predators to the island. Although Plan D would have the least environmental impacts it would not provide the navigation benefits desired by the town of Chatham. Of the remaining plans, Plan B would create the least environmental damage. This plan is already used by the town of Chatham to restore the navigation channel. No intertidal habitat would need to be altered and replaced.

C. Endangered, Threatened, and Rare Species

No impacts to Federally listed threatened or endangered species, or State listed species are expected.

D. Historical and Archaeological Resources

There are 55 known historic shipwrecks off of Chatham. However, it is unlikely that any of these historic wrecks are in the vicinity of the proposed Federal navigation project area. According to a 1910 map (Walker), Tern Island was a peninsula attached to the mainland, with a breach of Nauset Beach directly opposite this peninsula.

Construction of a jetty or wall to deflect wave action from the pier and alleviate shoaling could have an effect on historic properties. When the final location and dimensions of the proposed jetty have been determined, then an evaluation of the site will determine the necessity of performing an archaeological survey.

The use of Tern Island as a disposal area should have no effect on historic properties. Tern Island has undergone many alterations. In 1606, the island was present only as a sandy shoal, while by 1847, it was connected to the mainland. It is likely that this process has occurred many times in this dynamic nearshore area. Due to the unstable nature of the island as well as the previous use of the area as a disposal site, the island should have a low potential for containing prehistoric sites.

There are no known prehistoric sites in the vicinity of Lighthouse Beach. However, it appears that this area would have prehistoric site sensitivity. In 1989, prehistoric archaeological deposits were observed actively eroding out of the embankment at Andrew Harding Lane (a short distance away). Beach nourishment at this area should have no effect on historic properties. Rather, disposal of sand on the beach would have the beneficial effect of reducing erosion of the embankment. However, if this project proceeds to a further stage of planning and design, then additional research and evaluation of the site would be performed to determine if an archaeological survey would be necessary.

The proposed Federal navigation project and disposal of dredged material at Tern Island should have no effect upon any structure or site of historic, architectural or archaeological significance as defined by the National Historic Preservation Act of 1966, as amended. If this project should proceed to design, then additional site investigations at Lighthouse Beach and the proposed jetty location will be completed.

E. Socioeconomic Impacts

The construction of a navigation channel in Aunt Lydia's Cove and Chatham Harbor would help to alleviate many of the damages and delays the fishermen are currently experiencing.

VI. Mitigation

The following measures would be taken to minimize environmental impacts from construction of a navigation project and disposal of dredged material.

1. Construction activities would be limited from September 1 to May 31 to avoid the spawning and growing season of benthic organisms and eelgrass for those areas where dredging and disposal activities would impact these resources.

2. Disposal on Tern Island would not be allowed when least terns or piping plovers are nesting unless the activity will not disrupt the birds. Nesting season generally begins in April and ends in August. Due to limited space on Tern Island and the limitations associated with bird habitat, long term disposal on Tern Island is not viable without a CDF.

3. If disposal on Tern Island is not feasible, disposal will occur at other eroding sites or for some other beneficial use where possible. Disposal will not be allowed to occur in saltmarsh, eelgrass beds or other sensitive habitats.

VII. Coordination

Representatives from the following agencies were invited to attend a field trip to the project area on May 20, 1991. This field trip was scheduled to allow other agencies the opportunity to view the project area and to discuss proposed alternatives. The invited agencies include:

U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
National Marine Fisheries Service
National Park Service
Massachusetts Coastal Zone Management Office
Massachusetts Division of Marine Fisheries
Massachusetts Division of Water Pollution Control
Chatham Conservation Commission
Chatham Shellfish Constable
Chatham Harbor Master

These and other offices were also invited to send comments on the proposed project. Their responses can be found in Appendix 1-III.

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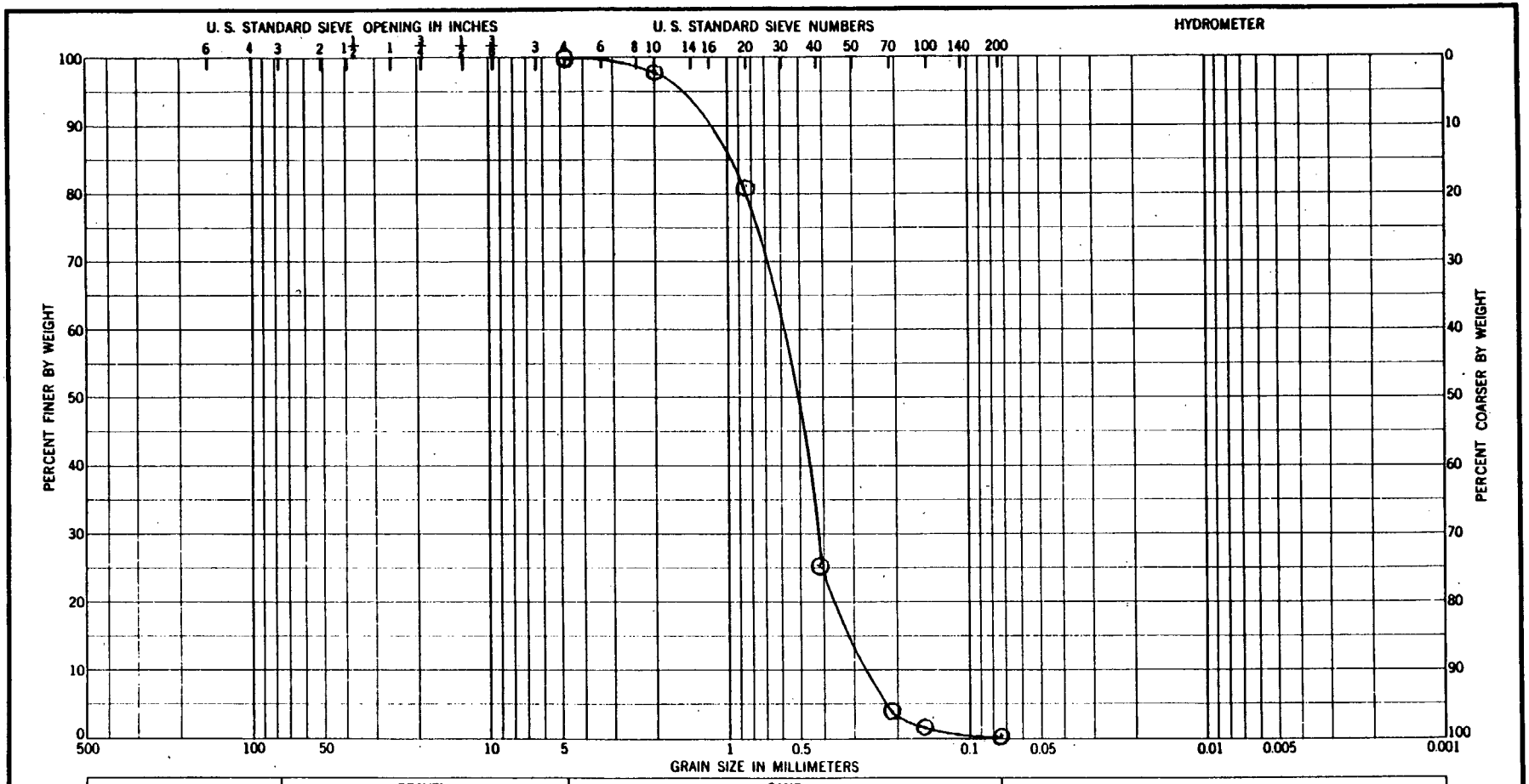
Appendix A - Grain Size Curves and Sediment Chemistry

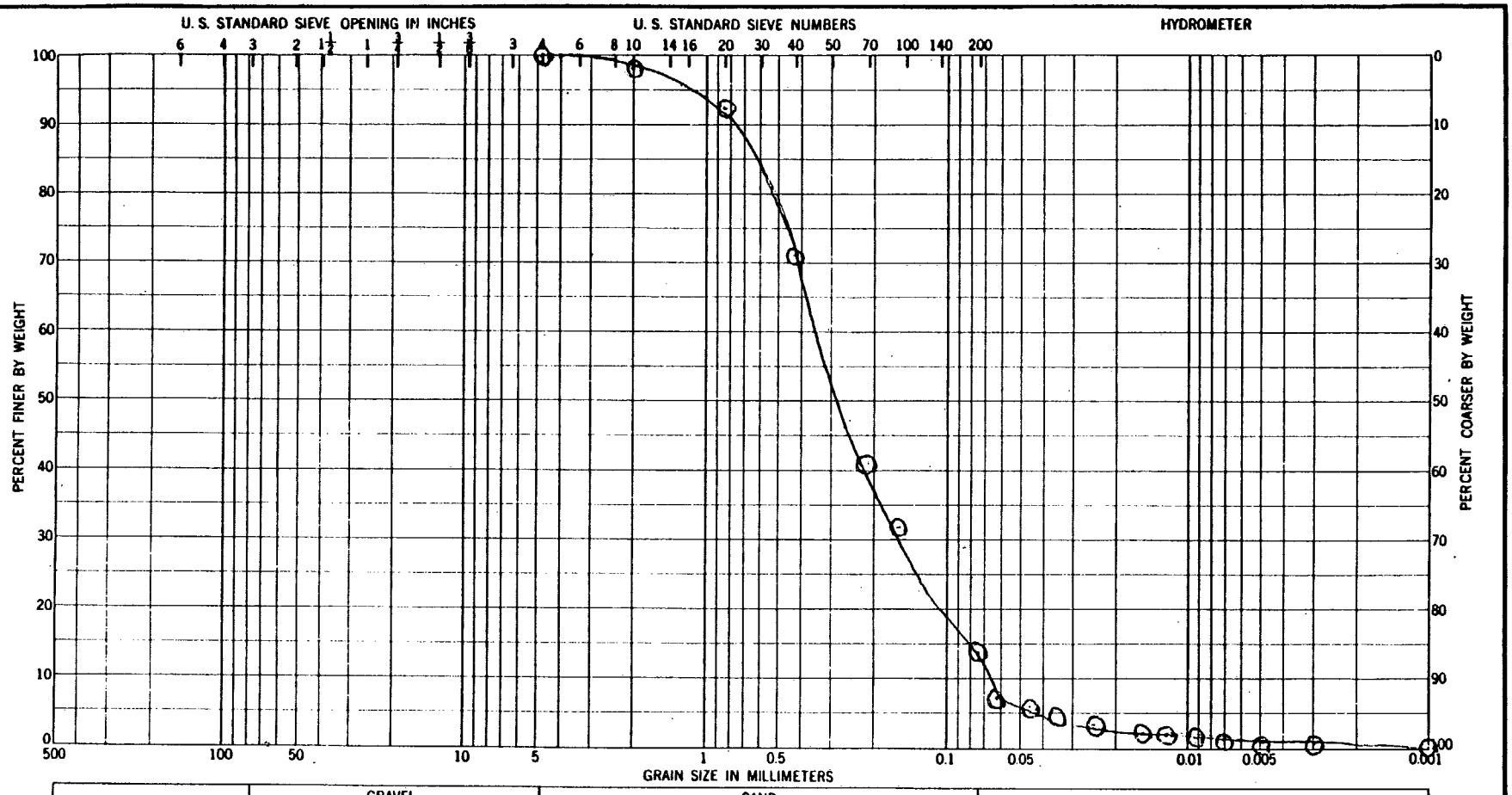


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"A"	0.0'-1.25'	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: MARINE ODOR SFG: 2.58				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB
Boring No. 100-542-1
Date JUNE 11, 1991

ENG FORM 1 MAY 63 2087



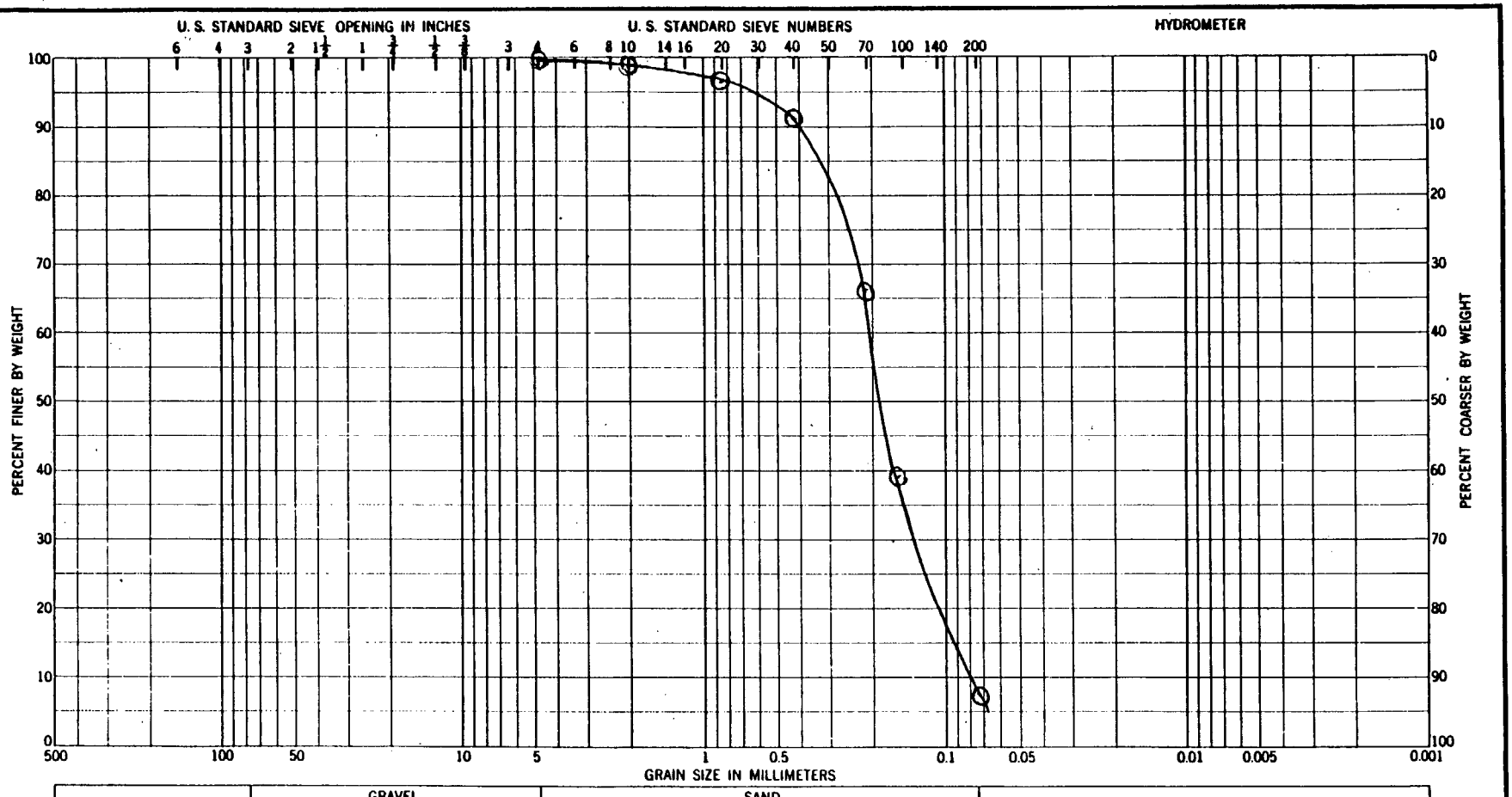
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"A"	1.25'-2.8'	SILTY SAND (SM) COLOR: BLACK ODOR: MARINE ODOR SPG: 2.59				

GRADATION CURVES

Project CHATHAM, HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB Boring No. 100-542-1
Date JUNE 11, 1991

ENG FORM 1 MAY 63 2087

VOLATILES E.P.A.: 3.34 | VOLATILES N.E.D.: 2.11

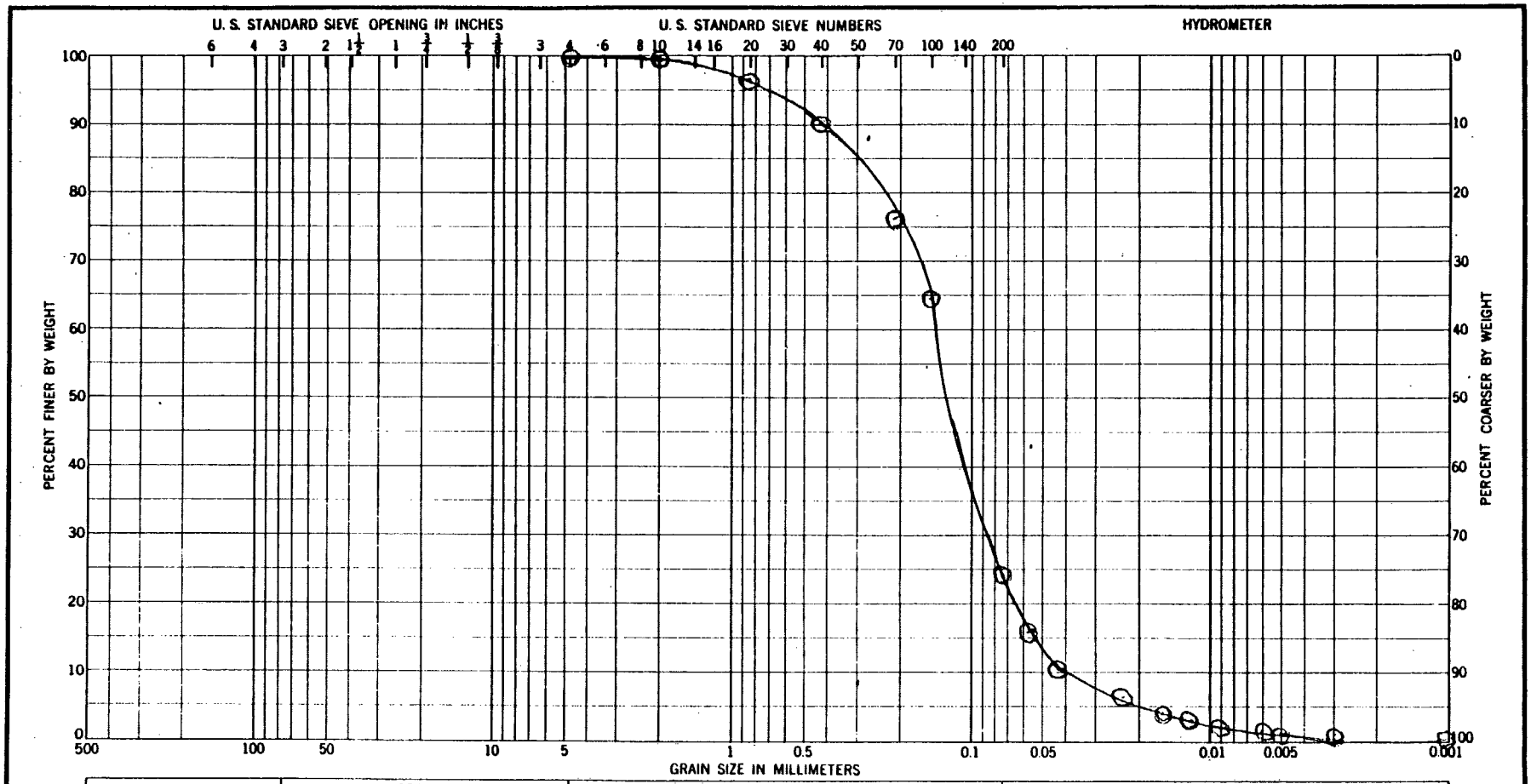


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"B"	0.0"–0.5"	POORLY GRADED SAND WITH SILT (SP-SM) COLOR: GREY TO BLACK ODOR: MARINE ODOR				

GRADATION CURVES SPG. 2.67

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
Boring No. LAB. 100-542-3
Date JUNE 11, 1991

ENG FORM 1 MAY 63 2087



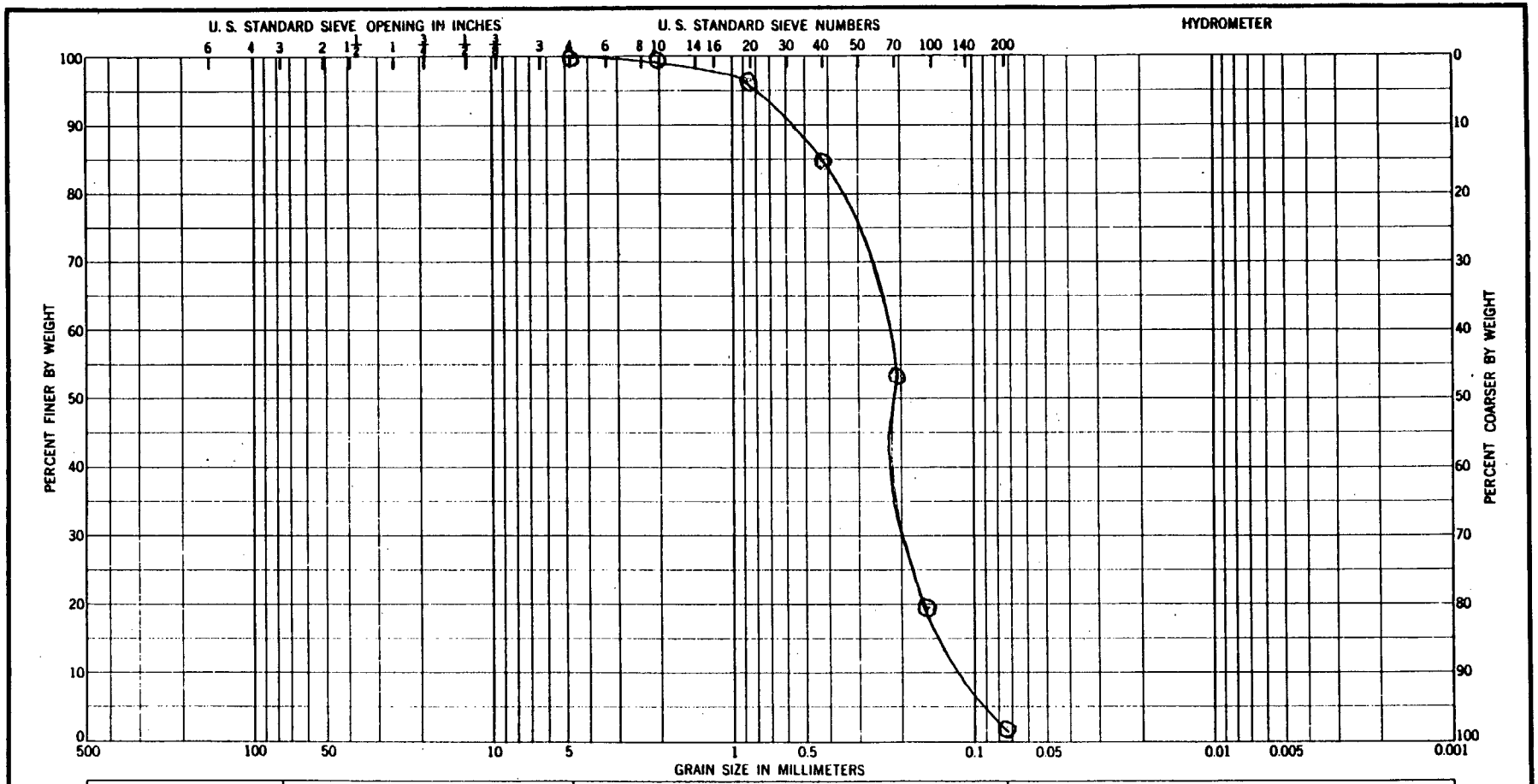
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"B"	0.5' - 1.7'	SILTY SAND (SM) COLOR: BLACK ODOR: MARINE ODOR SPG.: 2.68				

GRADATION CURVES

Project: CHATHAM HARBOR
CHATHAM, MASS.
Area: AUNT LYDIA'S COVE
LAB. Boring No.: 100-542-3
Date: JUNE 11, 1991

ENG FORM 1 MAY 63 2087

VOLATILES E.P.A.: 2.41 | VOLATILES N.E.D.: 1.47



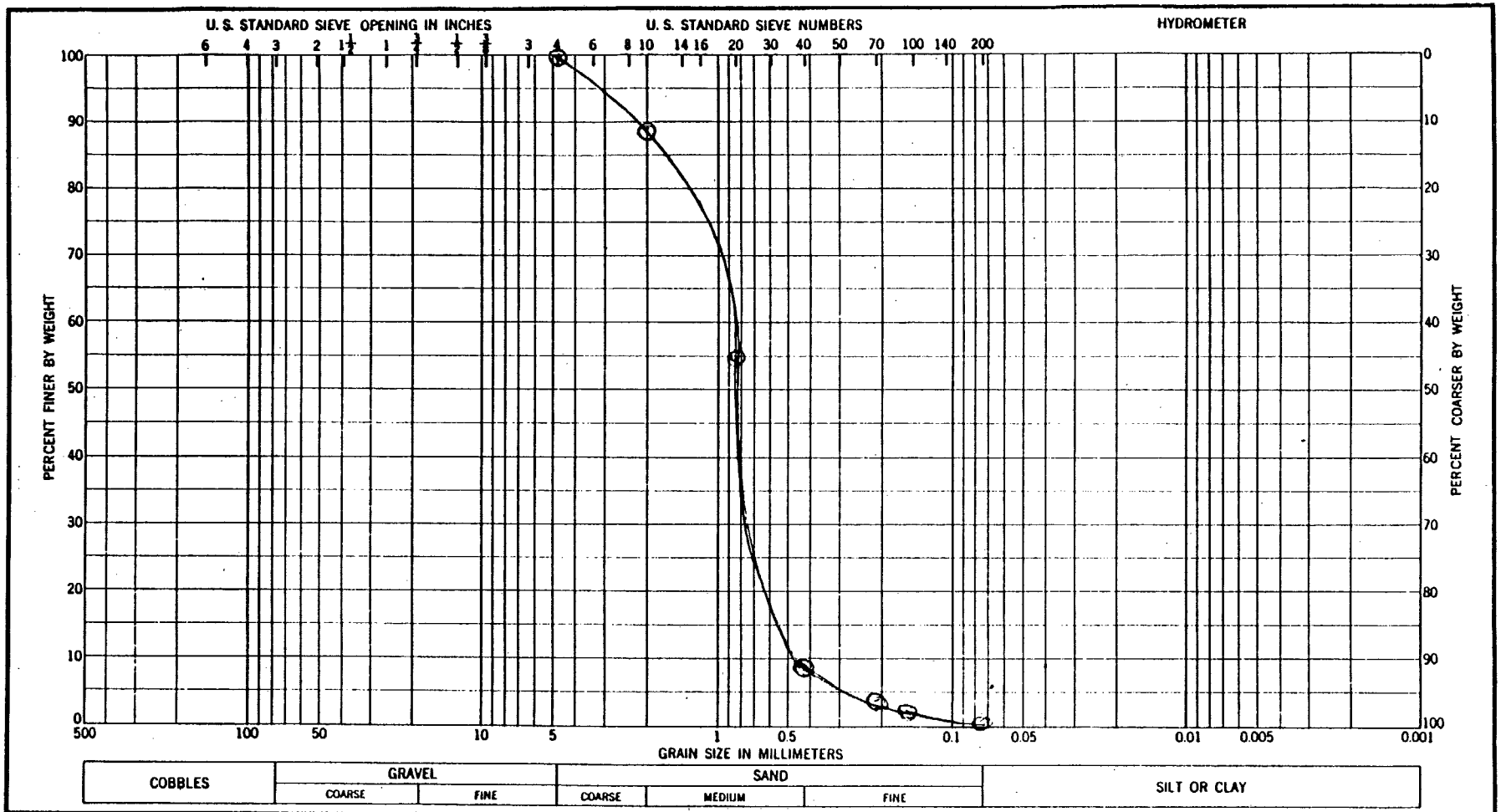
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"C"	0.0' - 1.3'	POORLY GRADED SAND (SP) COLOR: GREY TO BLACK ODOR: NONE PRESENT	30.6			

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIAS COVE
LAB
Boring No. 100-542-4
Date JUNE 11, 1991

ENG FORM 1 MAY 63 2087

WET UNIT WEIGHT @ 125.4 PCF (LBS/FT^3)
DRY UNIT WEIGHT @ 104.3 PCF (LBS/FT^3)



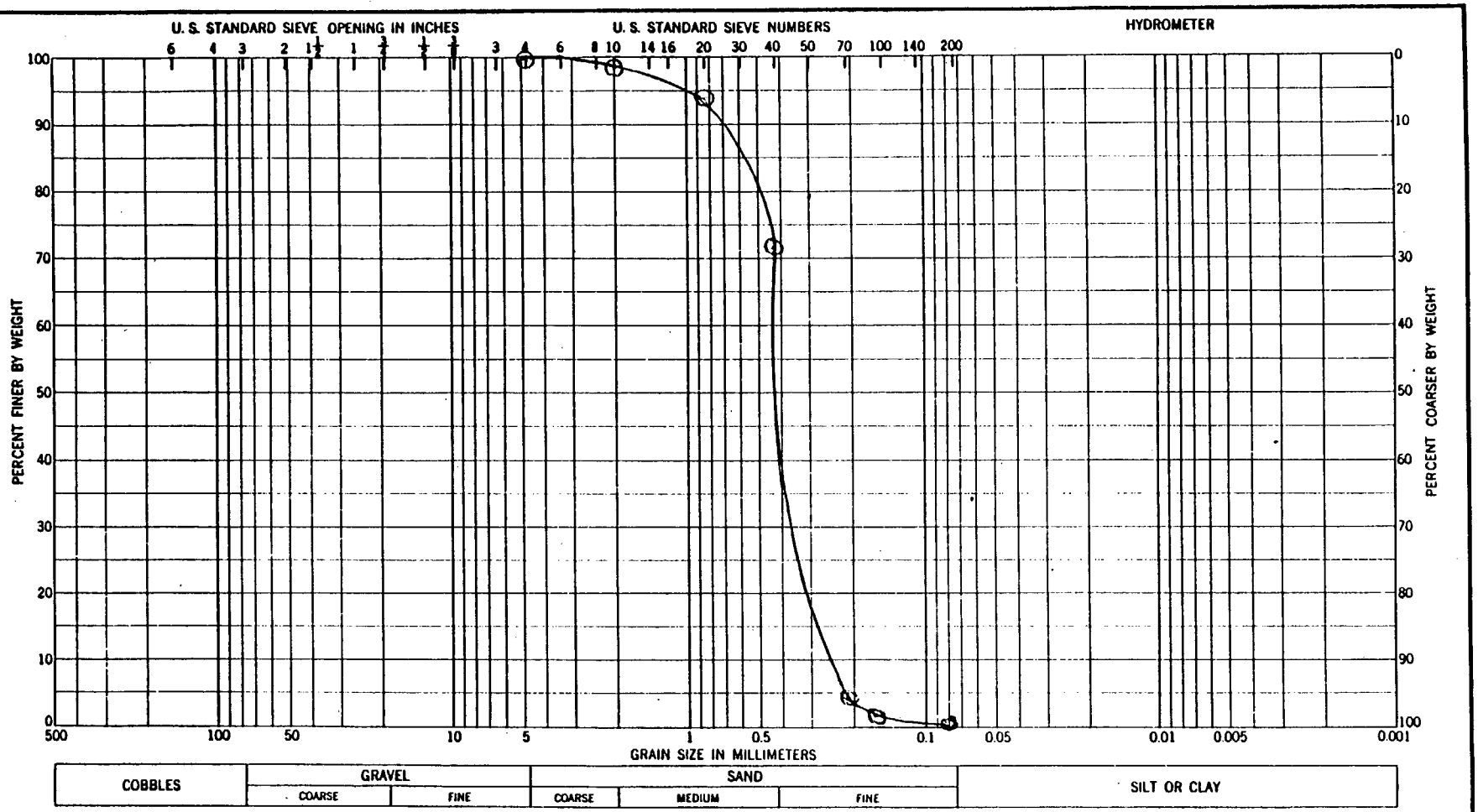
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"D"	0.0' -0.75'	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: NONE PRESENT	19.3			

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB
Boring No. 100-542-6
Date JUNE 13, 1991

ENG FORM 1 MAY 63 2087

WET UNIT WEIGHT @ 124.4 PCF (LBS/FT.^{3})
DRY UNIT WEIGHT @ 104.3 PCF (LBS/FT.^{3})



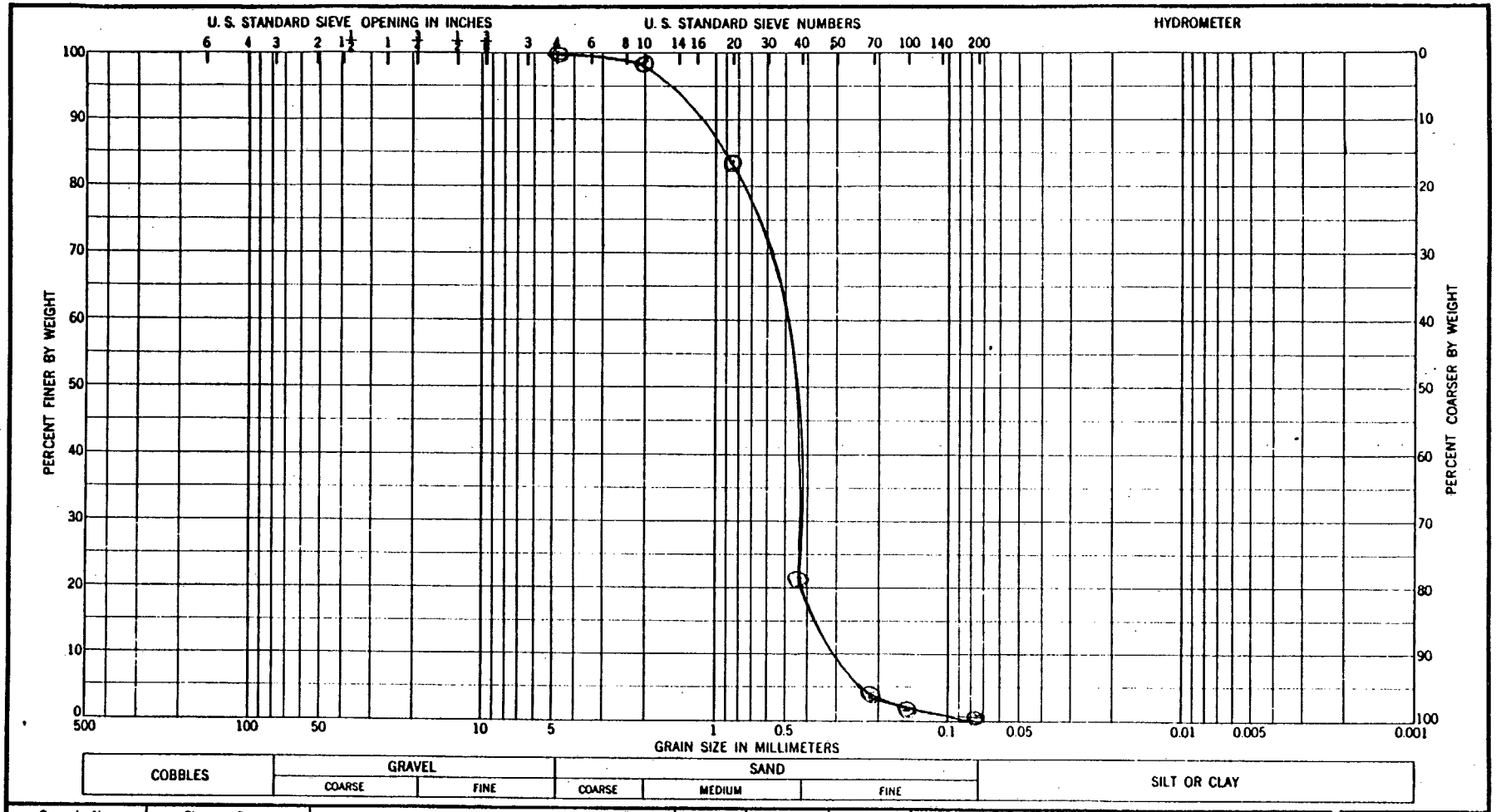
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"E"	0.0' – 1.4'	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: NONE PRESENT	21.4			

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB.
Boring No. 100-542-7
Date JUNE 13, 1991

ENG FORM 1 MAY 63 2087

WET UNIT WEIGHT @ 127.7 PCF (LBS./FT.^{3})
DRY UNIT WEIGHT @ 105.5 PCF (LBS./FT.^{3})

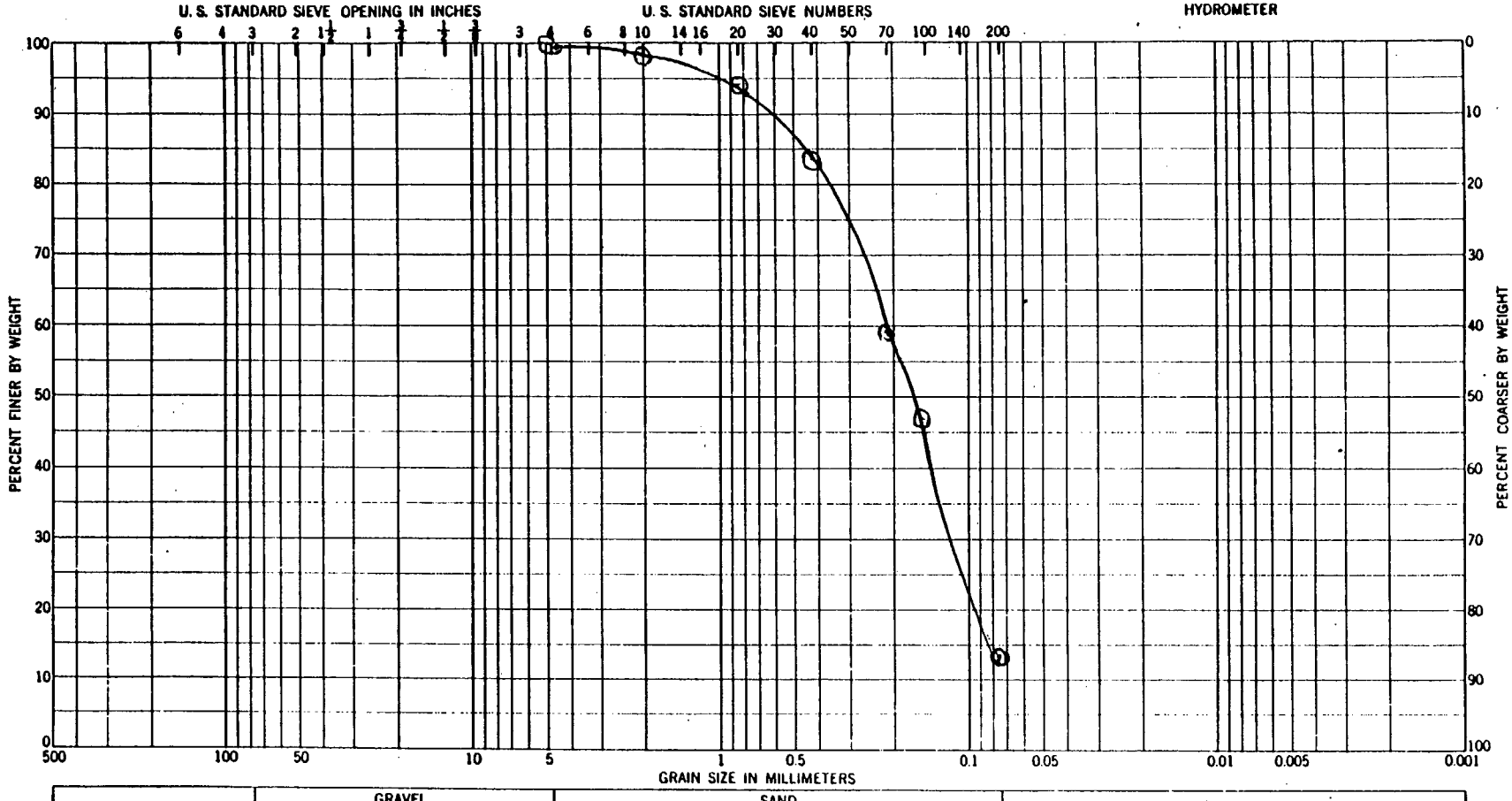


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"F"	0.0' – 1.0'	POORLY GRADED SAND (SP)				
		COLOR: LT. GREY				
		ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB
Boring No. 100-542-8
Date JUNE 13, 1991

ENG FORM 1 MAY 83 2087



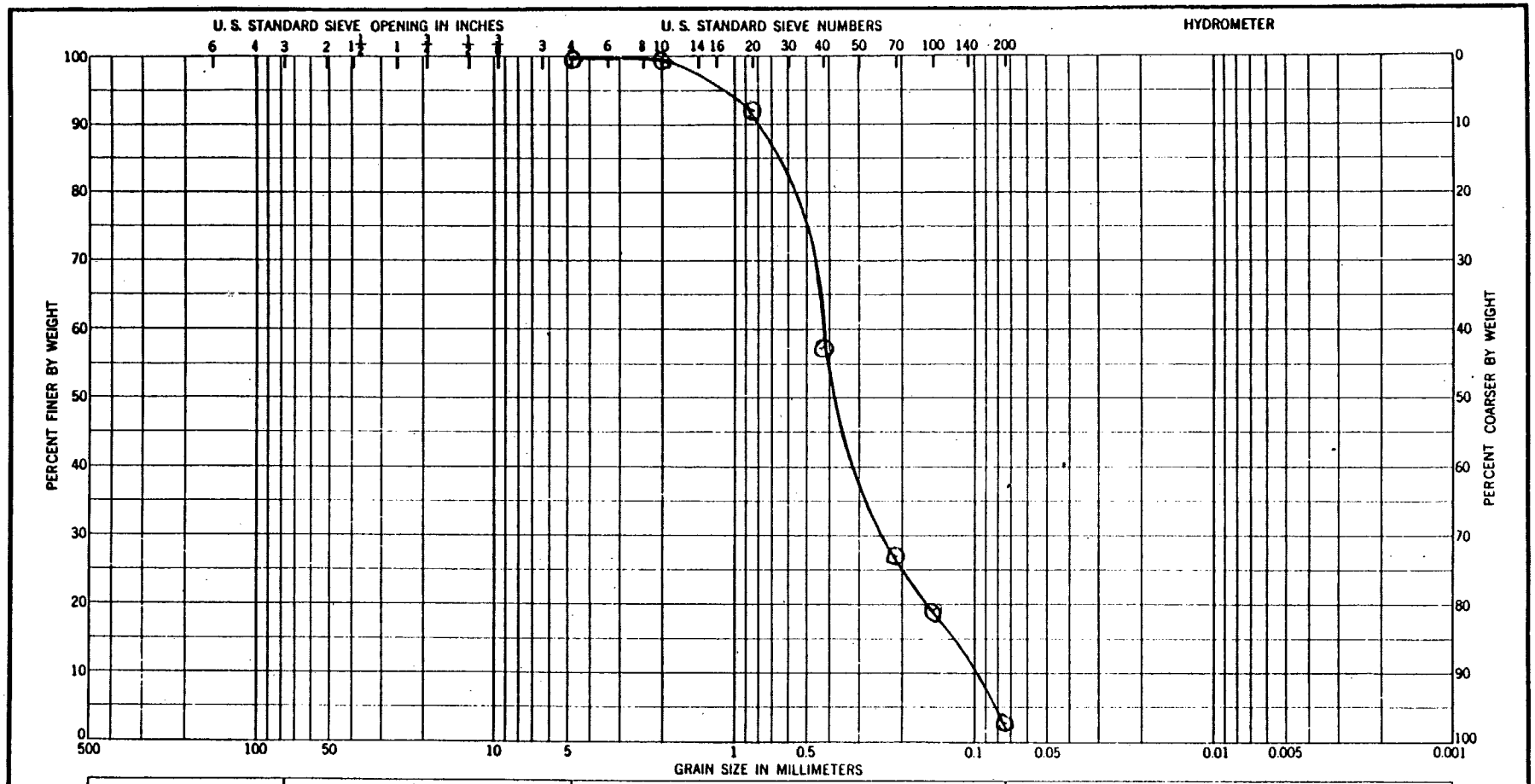
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"G"	0.0' – 2.0'	SILTY SAND (SM) COLOR: LT. GREY ODOR: NONE PRESENT	26.2			

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB. Boring No. 100-542-9
Date JUNE 13, 1991

ENG FORM 1 MAY 63 2087

WET UNIT WEIGHT @ 130.3 PCF (LBS./FT.^{3})
DRY UNIT WEIGHT @ 103.0 PCF (LBS./FT.^{3})



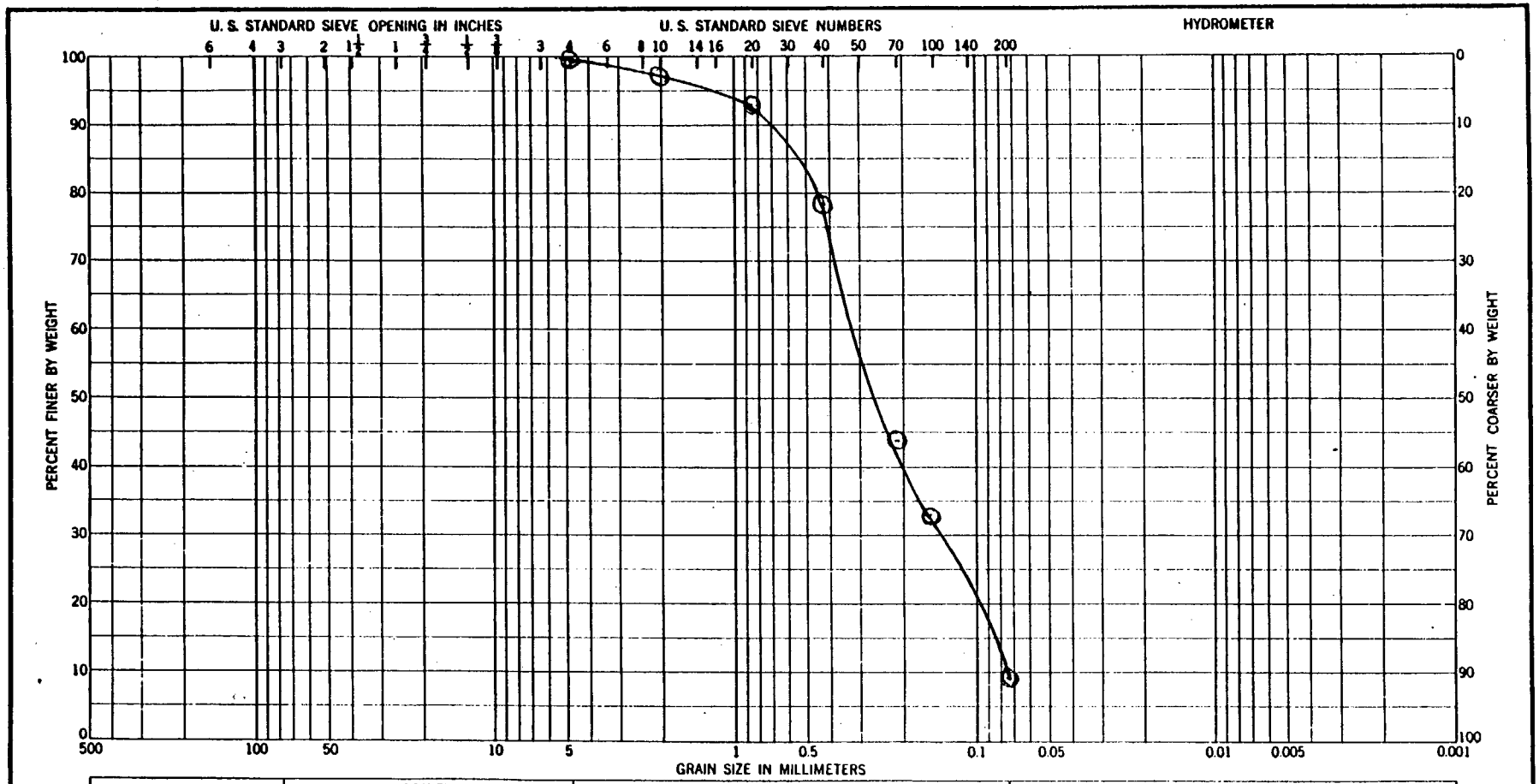
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"H"	0.0'-1.7'	POORLY GRADED SAND (SP) COLOR: GREY TO BLACK ODOR: NONE PRESENT	24.8			

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB. Boring No. 100-542-10
Date JUNE 13, 1991

ENG FORM 1 MAY 63 2087

WET UNIT WEIGHT @ 124.5 PCF (LBS./FT.^{3})
DRY UNIT WEIGHT @ 99.9 PCF (LBS./FT.^{3})



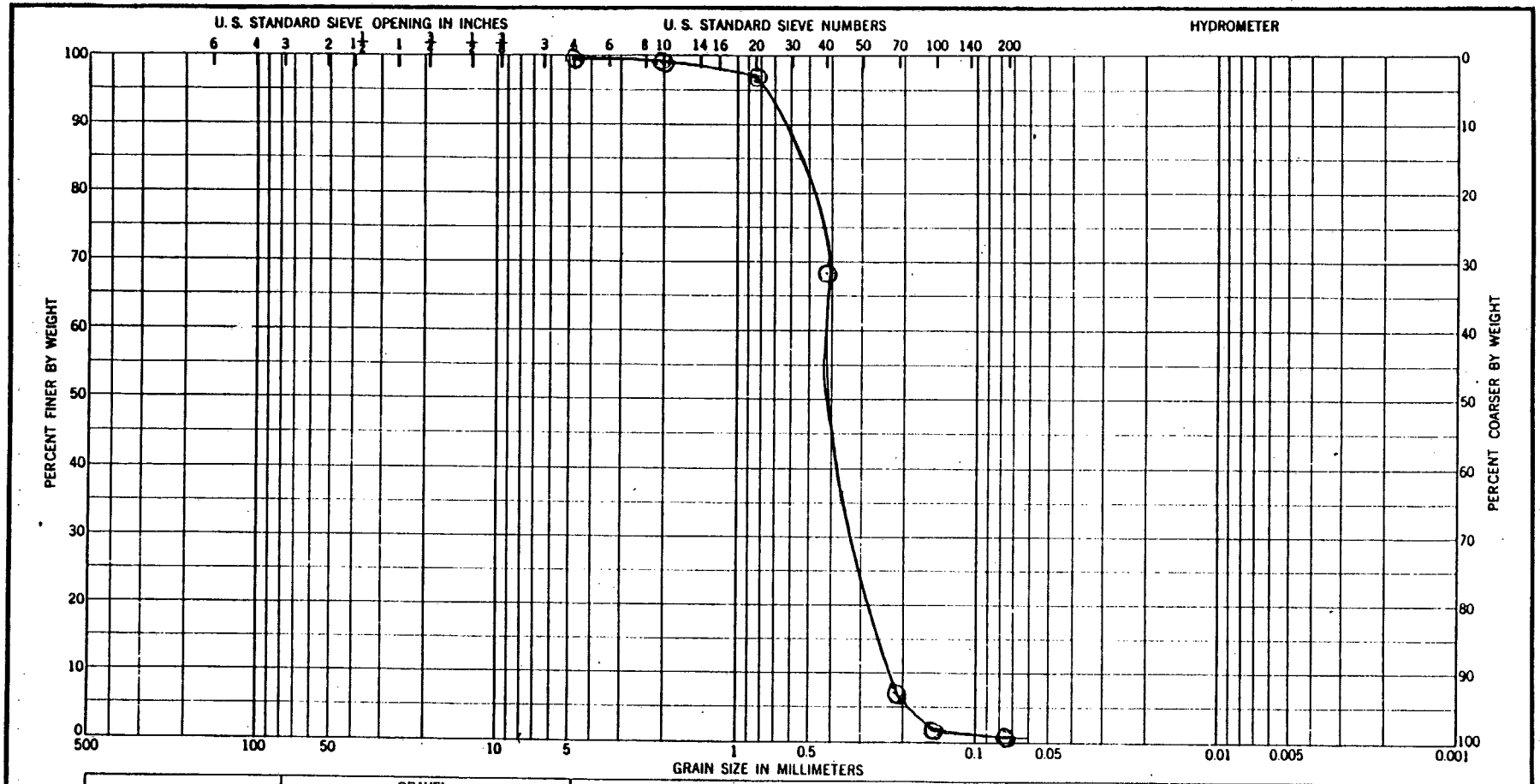
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"I"	0.0' – 1.4'	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: NONE PRESENT	19.7			

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB Boring No. 100-542-11
Date JUNE 13, 1991

ENG FORM 1 MAY 63 2087

WET UNIT WEIGHT @ 124.5 PCF (LBS./FT.^{3})
DRY UNIT WEIGHT @ 104.3 PCF (LBS./FT.^{3})

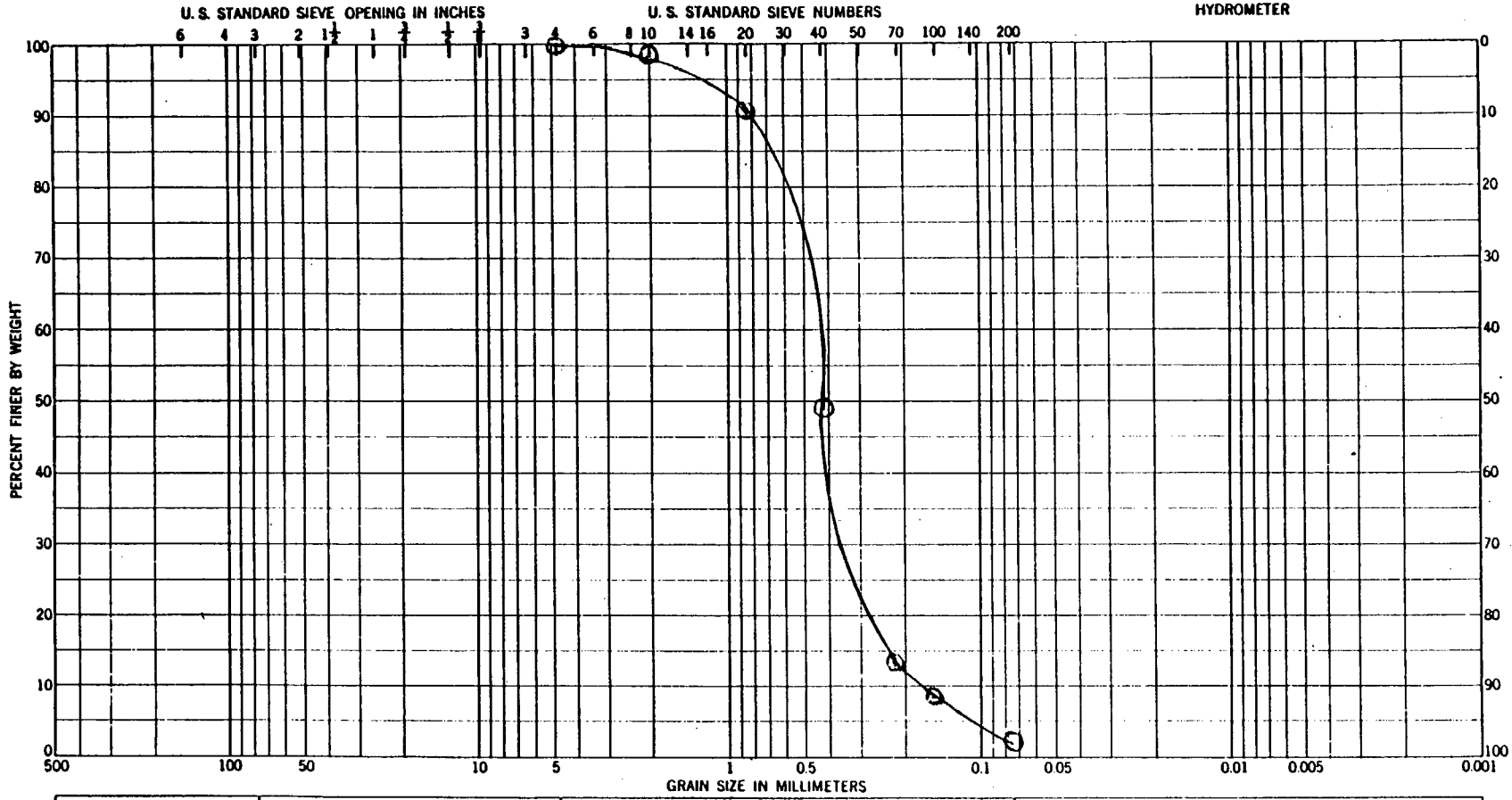


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"J"	0"-6" SURFACE	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
Boring No. 100-542-12
Date JUNE 14, 1971

ENG FORM 1 MAY 63 2087

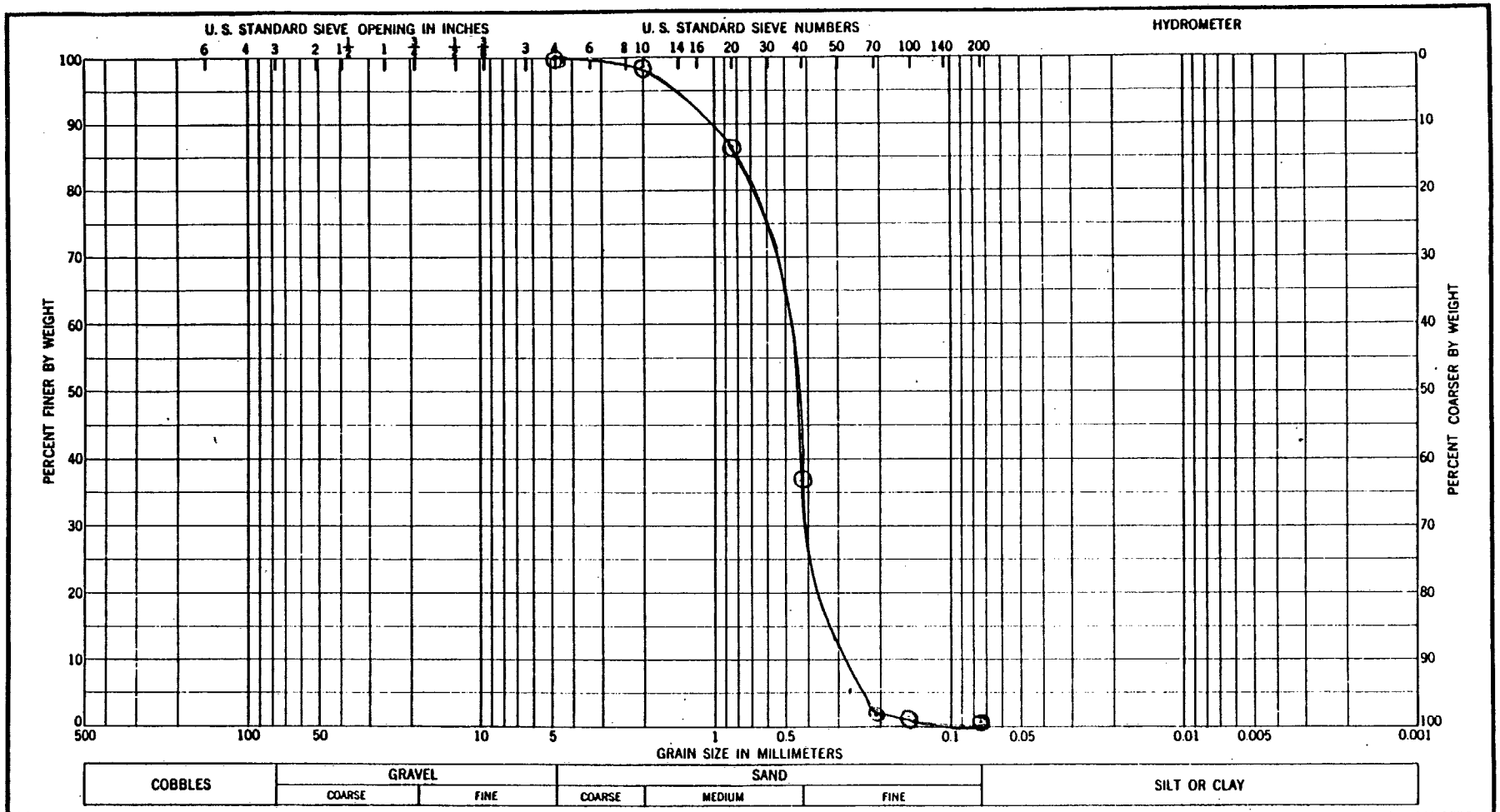


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"K"	0" - 6" SURFACE	POORLY GRADED SAND (SP)				
		COLOR: LT. BROWN				
		ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIAS COVE
LAB Boring No. 100-542-13
Date JUNE 14, 1991

ENG FORM 1 MAY 63 2087

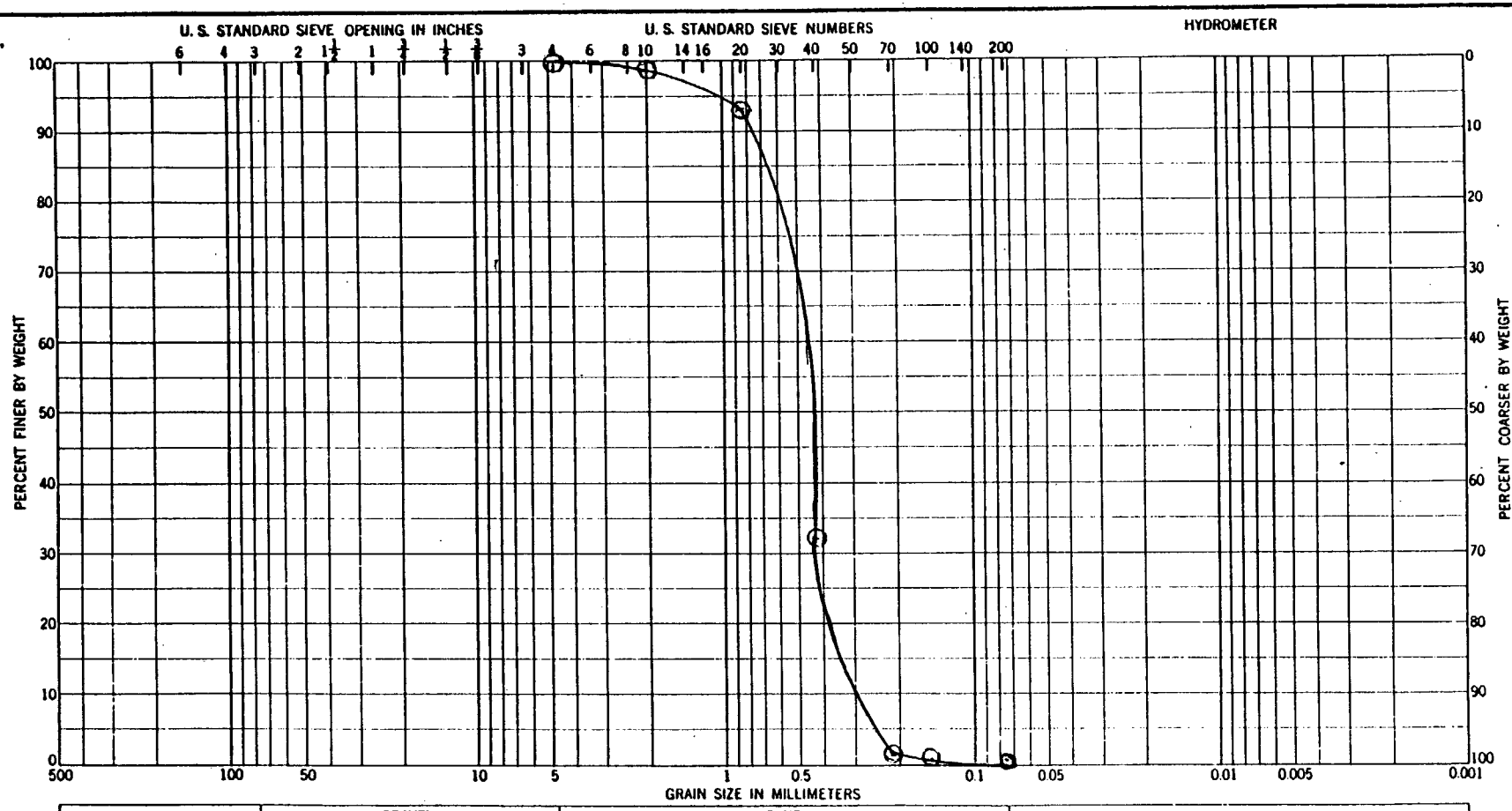


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"L1"	0" – 6" SURFACE	POORLY GRADED SAND (SP) COLOR: LT. BROWN ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB. Boring No. 100-542-14
Date JUNE 14, 1991

ENG FORM 1 MAY 63 2087

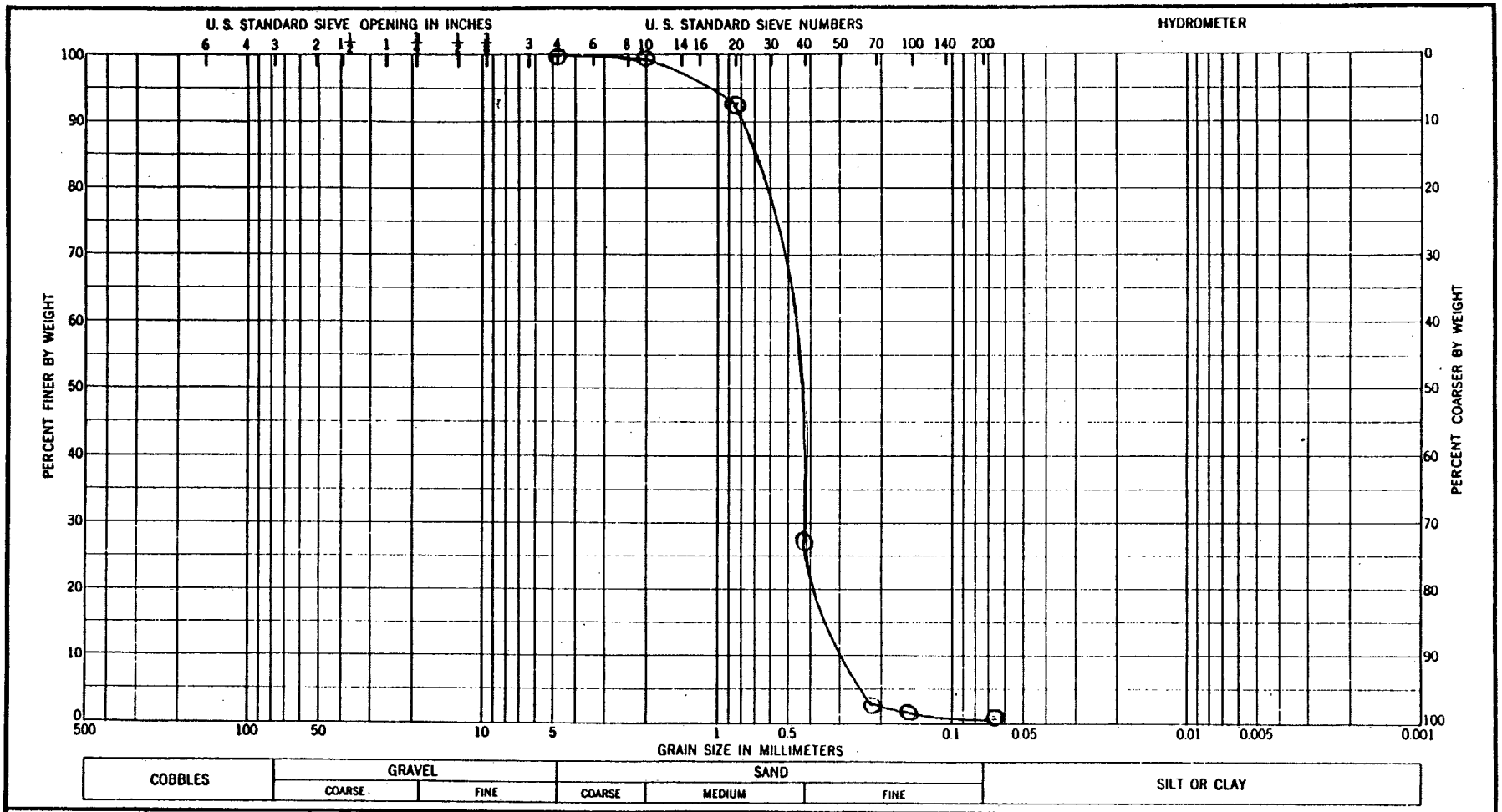


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"M"	SURFACE	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB Boring No. 100-542-16
Date JUNE 14, 1971

ENG FORM 1 MAY 63 2087

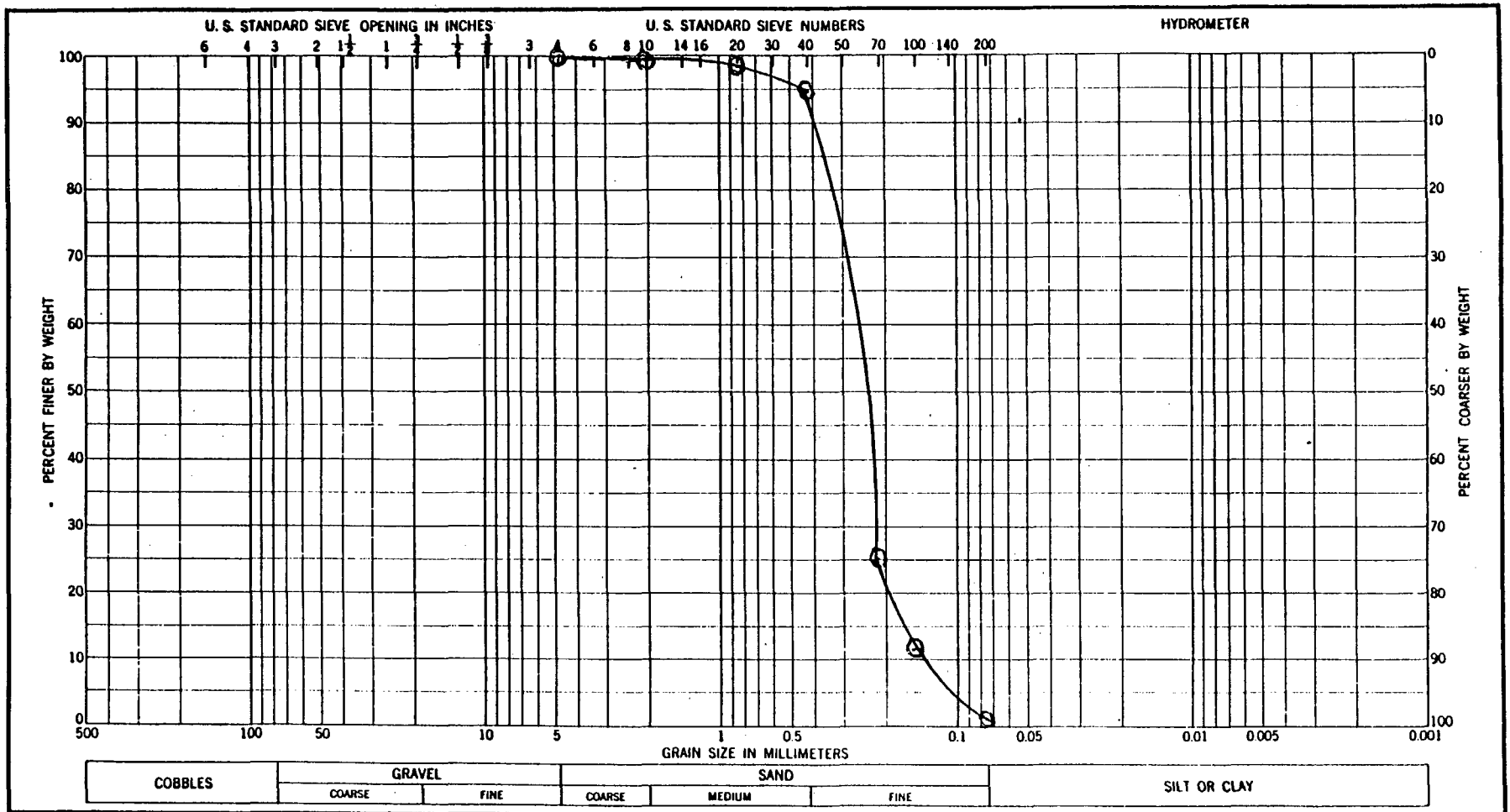


Sample No.	Elev or Depth	Classification	Nat w,%	LL	PL	PI
"N"	SURFACE	POORLY GRADED SAND (SP)				
		COLOR: LT. GREY				
		ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB Boring No. 100-542-17
Date JUNE 14, 1971

ENG FORM 1 MAY 63 2087

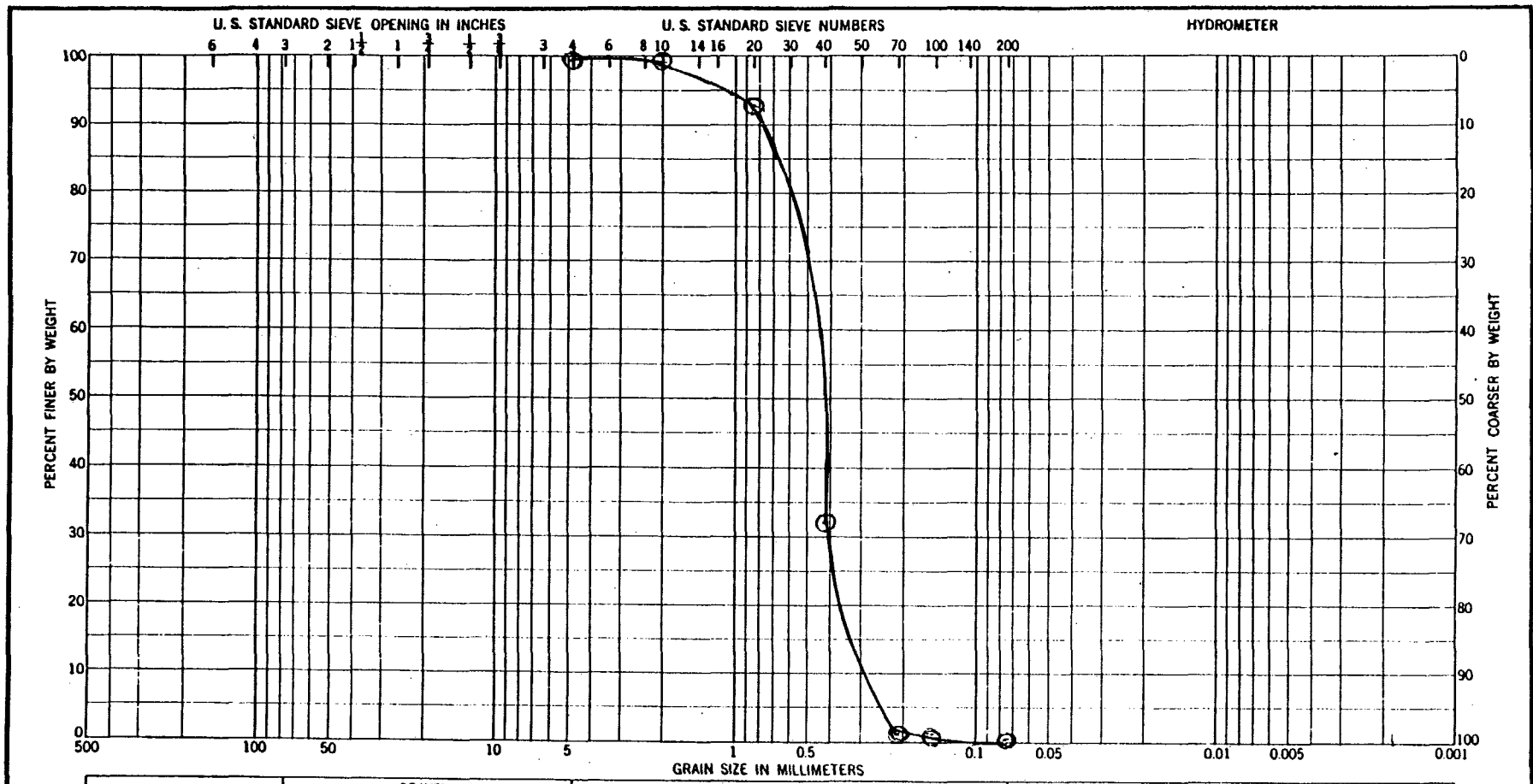


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"O"	SURFACE	POORLY GRADED SAND (SP) COLOR: LT. GREY ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB. Boring No. 100-542-18
Date JUNE 14, 1991

ENG FORM 1 MAY 63 2087

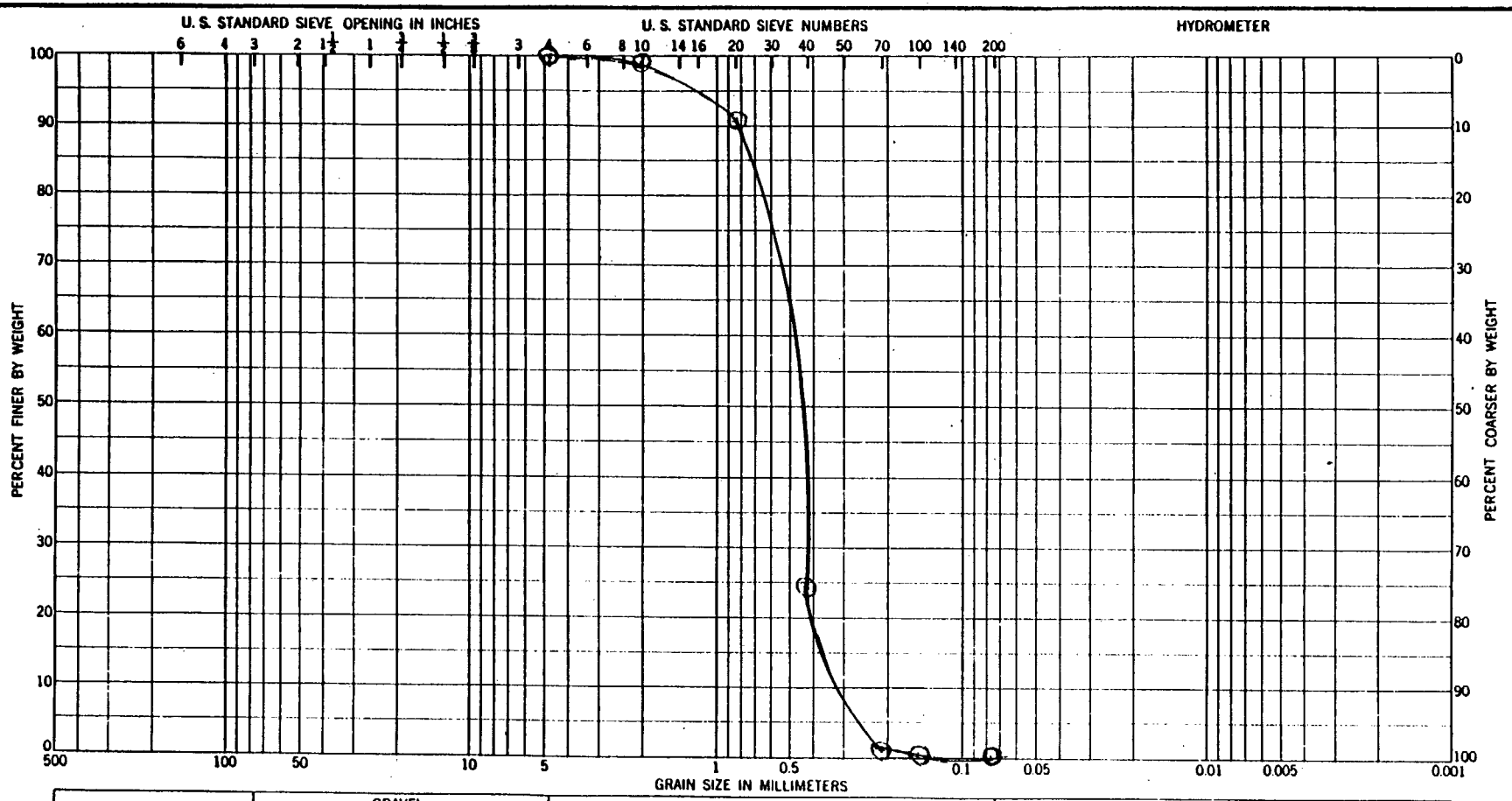


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"FRONT OF WALK"	0"–6" SURFACE	POORLY GRADED SAND (SP) COLOR: LT. BROWN ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB
Boring No. 100-542-21
Date JUNE 14, 1971

ENG FORM 1 MAY 63 2087

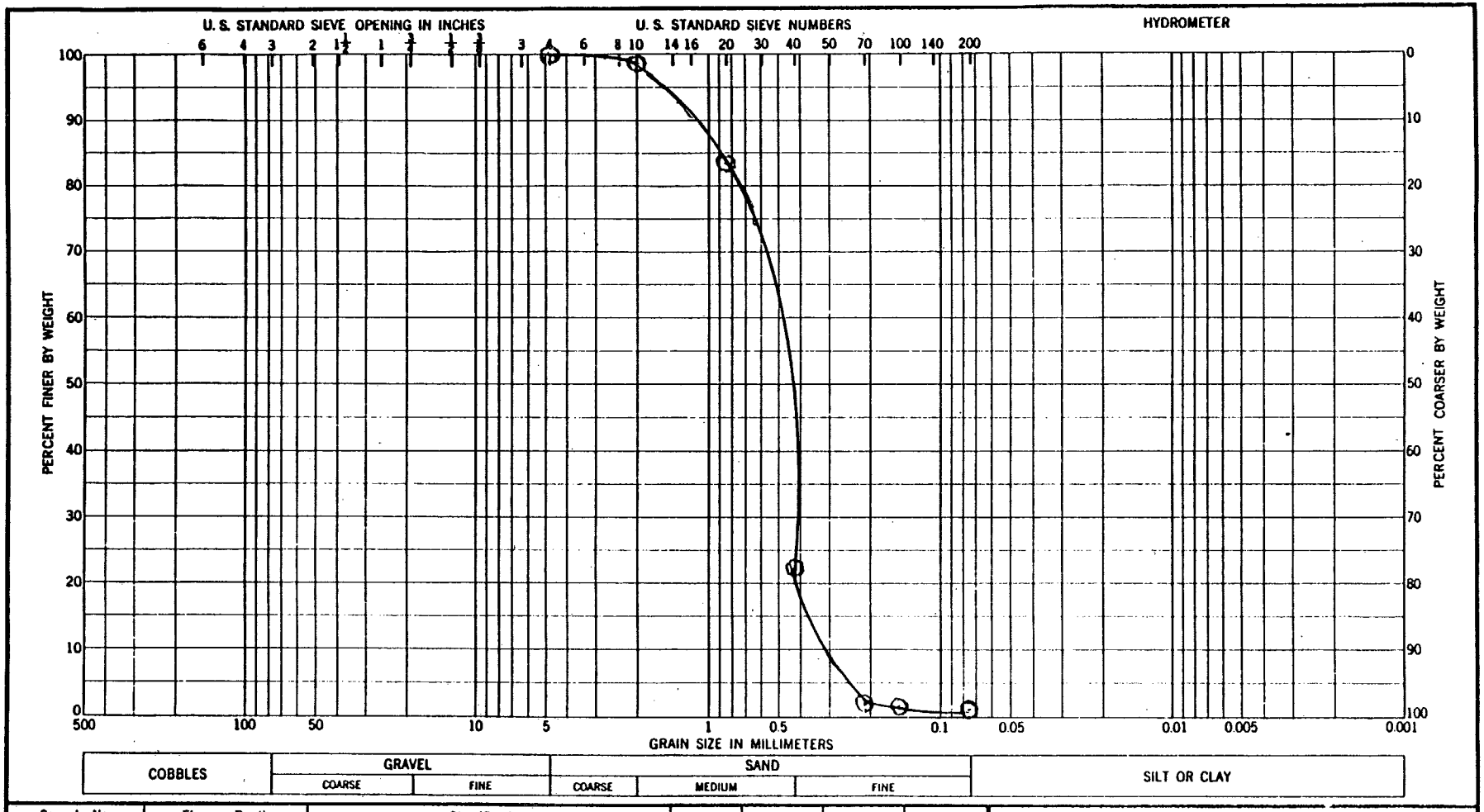


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"FRONT OF MASTHEAD"	0" – 6" SURFACE	POORLY GRADED SAND (SP) COLOR: LT. BROWN ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area ALONT LYDIA'S COVE
LAB
Boring No. 100-542-22
Date JUNE 14, 1991

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
"TREE @ PARKING LOT"	0" - 6" SURFACE	POORLY GRADED SAND (SP)				
		COLOR: LT. BROWN				
		ODOR: NONE PRESENT				

GRADATION CURVES

Project CHATHAM HARBOR
CHATHAM, MASS.
Area AUNT LYDIA'S COVE
LAB Boring No. 100-542-23
Date JUNE 14, 1991

ENG FORM 1 MAY 63 2087

Analytical Data Report

Chatham - Aunt Lydia's Cove

U.S. Army Corps of Engineers
New England Division
Environmental Laboratory
Hubbardston, MA 01542

Date: 28 June 1991

William A. Saner
Acting Chief, Environmental Laboratory

TABLE OF CONTENTS

1. CASE SUMMARY

CHATHAM - AUNT LYDIA'S COVE

1. Two sediment samples were received for the above subject project on May 17, 1991. A copy of the chain-of-custody record is enclosed for your reference.

2. The following analyses were performed in-house.

Analysis	EPA Method
Total Organic Carbons	9060
PCBs	3540/8080
Pesticides	3540/8080
Arsenic	3050/7060
Cadmium	3050/7131
Chromium	3050/7190
Copper	3050/7210
Lead	3050/7421
Mercury	3050/7470
Nickel	3050/7520
Zinc	3050/7950
Semi-Volatile Organics	3540/8270

2. SAMPLE LISTING

CHATHAM - AUNT LYDIA'S COVE

SAMPLE LISTING

ENV. NO.	DATE	FIELD DESCRIPTION	MATRIX
13093	5/17/91	1.5 - 2.8'	Sediment
13094	5/17/91	0.5 - 1.7'	Sediment

3. LABORATORY DATA

NEW ENGLAND DIVISION, ENVIRONMENTAL LABORATORY

PRODUCED ON 06/27/91
08:34

CHATHAM - AUNT LYDIA'S COVE

METHOD 8080: PESTICIDES - SOIL (ug/kg)

PARAMETER		13093 1.5-2.8' SOIL		13094 0.5-1.7' SOIL		METHOD BLANK SOIL
Alpha-BHC	<	3.8	<	3.8	<	2.0
Gamma-BHC (Lindane)	<	3.8	<	3.8	<	2.0
Beta-BHC	<	3.8	<	3.8	<	2.0
Heptachlor	<	3.8	<	3.8	<	2.0
Delta-BHC	<	3.8	<	3.8	<	2.0
Aldrin	<	3.8	<	3.8	<	2.0
Heptachlor epoxide	<	3.8	<	3.8	<	2.0
Endosulfan I	<	3.8	<	3.8	<	2.0
4,4'-DDE	<	7.7	<	7.7	<	4.0
Dieldrin	<	7.7	<	7.7	<	4.0
Endrin	<	7.7	<	7.7	<	4.0
4,4'-DDD	<	7.7	<	7.7	<	4.0
Endosulfan II	<	7.7	<	7.7	<	4.0
4,4'-DDT	<	7.7	<	7.7	<	4.0
Endrin aldehyde	<	7.7	<	7.7	<	4.0
Endosulfan sulfate	<	7.7	<	7.7	<	4.0
Methoxychlor	<	38	<	38	<	20
Surrogate Recovery (%)						
Dibutyl chlorendate		63	*			54
TCMX		86		82		80
SAMPLE DATE:		5/16/91		5/16/91		5/16/91
DATE EXTRACTED:		5/28/91		5/28/91		5/28/91
DATE ANALYZED:		5/30/91		5/30/91		5/30/91

NOTE:
* - Matrix effect.

NEW ENGLAND DIVISION, ENVIRONMENTAL LABORATORY

PRODUCED ON 06/27/91
09:56

CHATHAM - AUNT LYDIA'S COVE

METHOD 8080: PESTICIDES - SOIL (ug/kg)

PARAMETER		METHOD BLANK SOIL		MS-METHOD BLANK SOIL		MSD-METHOD BLANK SOIL
Alpha-BHC	<	2.0	<	1.0	<	1.0
Gamma-BHC (Lindane)	<	2.0		75 %		89 %
Beta-BHC	<	2.0	<	1.0	<	1.0
Heptachlor	<	2.0		85 %		99 %
Delta-BHC	<	2.0	<	1.0	<	1.0
Aldrin	<	2.0		83 %		98 %
Heptachlor epoxide	<	2.0	<	1.0	<	1.0
Endosulfan I	<	2.0	<	1.0	<	1.0
4,4'-DDE	<	4.0	<	4.0	<	4.0
Dieldrin	<	4.0		78 %		93 %
Endrin	<	4.0		91 %		108 %
4,4'-DDD	<	4.0	<	2.0	<	2.0
Endosulfan II	<	4.0	<	2.0	<	2.0
4,4'-DDT	<	4.0		91 %		104 %
Endrin aldehyde	<	4.0	<	2.0	<	2.0
Endosulfan sulfate	<	4.0	<	2.0	<	2.0
Methoxychlor	<	20	<	10	<	10
Surrogate Recovery (%)						
Dibutyl chlorendate		54		74		87
TCMX		80		80		93

SAMPLE DATE:	5/6		
DATE EXTRACTED:	5/28/91	5/28/91	5/28/91
DATE ANALYZED:	5/30/91	5/30/91	5/30/91

NEW ENGLAND DIVISION, ENVIRONMENTAL LABORATORY

PRODUCED ON 14-Jun-91
08:13 AM

CHATHAM - AUNT LYDIA'S COVE - TOC

METHOD 9060: TOTAL ORGANIC CARBONS (%)

ENV NO	FIELD DESCRIPTION	TOC (%)
13093	A-1.5-2.8'	0.44
13094	B-0.5-1.7'	0.36
METHOD BLANK		< 0.005

DATE ANALYZED: 6/4/91

NEW ENGLAND DIVISION, ENVIRONMENTAL LABORATORY

PRODUCED ON 06/28/91
14:09

CHATHAM - AUNT LYDIA'S COVE

TRACE METAL RESULTS - SOIL

PARAMETER	13093 A-1,5'-2.8'	13094 B-0.5'-1.7'	METHOD BLANK
Arsenic	2.3	2.9	< 0.050
Cadmium	0.15	0.11	< 0.050
Chromium	9.3	11	< 8.0
Copper	11	7.1	< 6.0
Lead	23	15	< 0.30
Mercury	< 0.03	< 0.03	< 0.030
Nickel	< 17	< 17	< 17
Zinc	37	33	* 10
SAMPLE DATE:	5/6/91	5/6/91	
DATE EXTRACTED:	6/12/91	6/12/91	6/12/91
DATE ANALYZED:	6/28/91	6/28/91	6/28/91

Note:

* Zinc Blank contaminated.
All results are reported in ppm unless otherwise indicated.

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION, ENVIRONMENTAL LABORATORY

PRODUCED ON 06/27/91
10:45

CHATHAM - AUNT LYDIA'S COVE

EPA METHOD : POLYNUCLEAR AROMATIC HYDROCARBONS (ug/g)

ANALYTE	13093 CHATHAM A 1.5'-2.8'	13094 CHATHAM B .05'-1.7'	METHOD BLANK
Napthalene	< 0.01	< 0.01	< 0.01
2-Methyl napthalene	< 0.01	< 0.01	< 0.01
Acenaphthylene	< 0.01	< 0.01	< 0.01
Acenaphthene	0.01	< 0.01	< 0.01
Fluorene	0.03	< 0.01	< 0.01
Phenanthrene	0.18	0.03	0.06
Anthracene	0.03	< 0.01	< 0.01
Fluoranthene	0.67	0.07	0.02
Pyrene	0.56	0.07	< 0.01
Benzo(a)anthracene	0.12	0.03	< 0.01
Chrysene	0.18	0.04	0.01
Benzo(b)fluoranthene	0.11	0.02	< 0.01
Benzo(k)fluoranthene	0.11	0.02	< 0.01
Benzo(a)pyrene	0.05	0.02	< 0.01
Dibenzo(a,h)anthracene	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	< 0.01	< 0.01	< 0.01
DILUTION FACTOR	0.11	0.11	0.10
Surrogate Recoveries (%)			
2-Fluorobiphenyl	78.5	85.7	79.0
Nitrobenzene-05	86.9	91.8	86.9
Terphenyl-014	95.1	102.3	90.2

SAMPLE DATE:	5/6/91	5/7/91	
DATE RECEIVED:	5/17/91	5/17/91	
DATE EXTRACTED:	6/4/91	6/4/91	6/4/91
DATE ANALYZED:	6/24/91	6/24/91	6/24/91
TOTAL PAH	2.05	0.30	0.09

\# - Surrogate recovery outside of control limits.
J - Estimate value; greater than Detection Limit, but less than Practical Quantitation Limit.

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION, ENVIRONMENTAL LABORATORY

PRODUCED ON 06/28/91
11:38

CHATHAM - AUNT LYDIA'S COVE

PCBs (ppm)

PARAMETER	13093 A-1,5'-2.8'	13094 B-0.5'-1.7'	METHOD BLANK
	SOIL	SOIL	SOIL
Total PCBs	0.013	< 0.0048	< 0.0025
Surrogate Recovery (%)			
DBC	41	7.0	46
TCMX	75	75	75

SAMPLE DATE:	5/6/91	5/6/91	
DATE RECEIVED:	5/17/91	5/17/91	
DATE EXTRACTED:	5/28/91	5/28/91	5/28/91
DATE ANALYZED:	6/27/91	6/27/91	5/29/91

4. QUALITY ASSURANCE DATA

PESTICIDE MATRIX SPIKE-MATRIX SPIKE DUPLICATE

PRECISION

COMPOUND	MATRIX SPIKE RECOVERY (%)	MATRIX SPIKE DUPLICATE RECOVERY (%)	RELATIVE PERCENT DEVIATION (RPD)	QC LIMITS RPD	IN OR OUT OF QC LIMITS
Lindane	75	89	17	15	OUT
Heptachlor	85	99	15	20	IN
Aldrin	83	98	17	22	IN
Dieldrin	78	93	18	18	IN
Endrin	91	108	17	21	IN
4,4'-DDT	91	104	13	27	IN

ACCURACY

SPIKING COMPOUND	MATRIX SPIKE RECOVERY (%)	ACCEPTABLE RANGE	IN OR OUT OF QC LIMITS
Lindane	75	56 - 123	IN
Heptachlor	85	40 - 131	IN
Aldrin	83	40 - 120	IN
Dieldrin	78	52 - 126	IN
Endrin	91	56 - 121	IN
DDT	91	38 - 127	IN

TRACE METAL MATRIX SPIKE DUPLICATES

PRECISION

PARAMETER	MATRIX SPIKE RESULT	MATRIX SPIKE DUPLICATE RESULT	RELATIVE PERCENT DEVIATION (RPD)	RPD MAXIMUM	IN OR OUT OF QC LIMITS
Arsenic	10.0	11	10	30	IN
Cadmium	5.1	5.0	2	30	IN
Chromium	10.0	10.0	0	30	IN
Copper	24	24	0	30	IN
Lead	4.3	4.6	7	30	IN
Mercury	0.30	0.30	0	30	IN
Nickel	39	41	5	30	IN
Zinc	26	25	4	30	IN

TRACE METAL SPIKE RECOVERY

ACCURACY

PARAMETER	MATRIX SPIKE RESULT	SAMPLE RESULT	SPIKE ADDED	SPIKE RECOVERY %	CONTROL LIMITS REC	IN OR OUT OF QC LIMITS
Arsenic	10	< 0.50	10	100.0	75 - 125	IN
Cadmium	5.1	0.050	5.0	102.0	75 - 125	IN
Chromium	10	< 8.0	10	100.0	75 - 125	IN
Copper	24	< 6.0	25	96.0	75 - 125	IN
Lead	4.3	< 0.30	5.0	86.0	75 - 125	IN
Mercury	0.30	< 0.030	0.30	100.0	75 - 125	IN
Nickel	39	< 17	40	97.5	75 - 125	IN
Zinc	26	10	20	80.0	75 - 125	IN

NOTE:
Zinc Blank Contaminated.

POLYNUCLEAR AROMATIC HYDROCARBONS MATRIX SPIKE-MATRIX SPIKE DUPLICATE

PRECISION

COMPOUND	MATRIX SPIKE RECOVERY	MATRIX SPIKE DUPLICATE RECOVERY	RELATIVE PERCENT DEVIATION (RPD)	QC LIMITS RPD	IN OR OUT OF QC LIMITS
Acenaphthene	83	90	9	19	IN
Pyrene	91	106	15	36	IN

ACCURACY

SPIKING COMPOUND	MATRIX SPIKE RECOVERY	ACCEPTABLE RANGE	IN OR OUT OF QC LIMITS
Acenaphthene	83	31 - 137	IN
Pyrene	91	35 - 142	IN

* - Values outside QC limits.

Appendix II - Pleasant Bay Eelgrass Report

INCREASED PRODUCTIVITY PRODUCED BY THE NEW CHATHAM INLET; AS MEASURED BY CHANGES IN EELGRASS AND BLUE MUSSEL BEDS IN THE PLEASANT BAY AREA FROM 1982, To 1987, 1988 And 1990

by William Sargent

The Coastlines Project

of

The Associated Scientists at Woods Hole

Summary:

The following data compare the changes in acreage of eelgrass and blue mussel beds from the baseline amounts prior to the opening of the new Chatham Inlet (January 2, 1987) to the amounts in 1987, 1988 and 1990. A synoptic aerial survey of eelgrass beds in 1982 was used as the baseline data. It was compared to aerial surveys taken in 1987, 1988 and 1990.

Allen's Point to Chatham Light

The data show a 33% increase in eelgrass and mussel bed acreage from 1988 to 1990 in the area from Allen's Point to the southern end of the inlet where South Beach is in the process of welding to the Chatham mainland (Chatham Light). The increase shows that the eelgrass beds are recovering from high losses in the lower part of the bay where 88% of the losses occured when beds were smothered by sand from the new break. It is in line with the 12.9% and 11% overall increase in eelgrass observed throughout Pleasant Bay in 1987 and 1988 respectively (see footnote 1).

The data also show that 101.8 acres of newly established eelgrass beds and mussel beds (with less than 25% eelgrass) seen in 1987 and 1988 were scoured away by 1990. This represents a 98% loss of these newly established beds and indicates that tidal currents may still be increasing and altering channels in this compartment of the system, or possibly that the beds were removed by fishing dredges.

Footnote 1

Because it was difficult to distinguish between eelgrass beds and mussel beds on the 1:18000 aerial photographs used in this survey the 33% figure represents both eelgrass beds and mussel beds, the actual increase is probably closer to the 11% to 12.9% increases observed in 1988 and 1987.

Chatham Light (South Beach "Weld") to Monomoy Cut

The data also show an increase of 343.5 acres of new eelgrass and blue mussel beds from Chatham Light (the South Beach weld area) to the break in Monomoy Island. This represents a striking 1885% increase in acreage of eelgrass and mussels since 1982 and almost as much since 1988. It is difficult to distinguish between eelgrass and mussel beds from 1:18000 aerial photographs, however eelgrass beds indicate increased primary productivity and mussel beds indicate increased secondary productivity.

The gain in eelgrass and mussel acreage is the result of the nearly completed welding of South Beach to the mainland. This process has created a protected area, the equivalent of a new bay, that is rapidly filling in with eelgrass and mussels introducing two new highly productive habitats. The area holds the potential for becoming a significant new fishing ground for bay scallops (Aequipecten irradians), quahogs (Mercenaria mercenaria), as well as the already established blue mussels (Mytilus edulis) (see footnote 2). It will also become a nursery ground for numerous commercial species and a catchment area for southern species inflowing from Nantucket Sound.

Footnote 2

It is interesting to note that the recorded catches of mussels track closely with the eelgrass and mussel data. In 1982, "few" blue mussels were landed, in 1983, 23,000 bushels of mussels were landed, in 1986 90,000 bushels were landed, and in 1987 95,000 bushels were landed. These were mostly dredged in the area inshore of the new inlet and were smothered by the breach in 1987.

In 1988 no mussels were landed, in 1989 30,000 mussels were landed and in 1990 100,000 bushels were landed these were mostly caught in "New South Bay" south of the area where South Beach is welding to the shore (personal communication Stuart Moore Chatham shellfish warden).

Pleasant Bay has traditionally been the northernmost limit of the range of many southern species and the southernmost limit for many northern species, thus this new geological feature will also tend to reduce the population of some southern species in Pleasant Bay and exclude some northern species from the new bay area.

Two examples of species expected to be affected are blue crabs (Callinectes sapidus) and horseshoe crabs, (Limulus polyphemus). A large portion of the recruitment of blue crabs into Pleasant Bay comes from plankton drifting in from southern waters, and most of the natural population of horseshoe crabs migrate inshore from continental shelf areas south of Pleasant Bay. Seals and birds already seem to be attracted to this area because of the predator free islands, the favorable water circulation and the mussels, horseshoe crab eggs, winter flounder and baitfish and plankton attracted by the new habitats.

Although the geology of this area is dynamic, the general characteristics and favorable water circulation patterns are likely to remain stable, thus maintaining the high productivity of this new area for several decades. The town of Chatham may want to initiate a small scale experimental seeding program to establish new populations of bay scallops or quahogs in this area. This would partially compensate the town for the minor loss of habitat caused by the break and the more severe loss of the common flats caused by the break in Monomoy in 1978.

Appendix III - Coordination Letters

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

September 24, 1991

Mr. Joseph L. Ignazio, Chief
Planning Division
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

This responds to your letter requesting comments on the Army Corps of Engineers' Navigation Improvement Study (107) for Aunt Lydia's Cove in Chatham, Massachusetts.

The following comments and recommendations are a preliminary response to the three proposed alternatives. Plan A is to dredge a 6-foot channel south of Tern Island and maintain the Aunt Lydia's Cove Anchorage. Plan B proposes to dredge a 6-foot channel around the north end of Tern Island and to maintain the Aunt Lydia's Cove Anchorage. And alternative plan C would dredge a 6-foot channel south of Tern Island, maintain the Aunt Lydia's Cove Anchorage, and construct a 900-foot rubblemound jetty just south of the anchorage.

All three alternatives call for dredging of between 20,000 to 40,000 cubic yards of sand to maintain the channel. The disposal would be at Tern Island. Because of the the need to dredge the channel constantly, the establishment of invertebrates and shore birds would become very unlikely because of the continuous pumping of sand on the Island's beach and sandflats. Another alternative to consider would be beach nourishment at nearby beaches such as Lighthouse Beach or North Beach.

Alternative C would construct a rubblemound jetty. We would need more information on this proposal before making a technical evaluation.

In a previous letter regarding the breaching issues affecting the entire Chatham barrier beach system, we recommended that the area be left alone. We further suggested that the COE ask its Waterways Experiment Station to investigate the hydrology and sediment transport characteristics of each of the alternatives. We believe that natural sediment transport will cause the area to fill in. This is based on the technical publication of Woods Hole Oceanographic Institution entitled, "Development, Characteristics and Effects of the New Chatham Harbor Inlet" by G. S. Giese, D. G. Aubrey and J. T. Liu. Based on the valuable commerical and research shellfish resources, along with numerous marine fish which use the area during critical life stages, we recommend that your

agency consider other less disruptive alternatives.

One suggestion that warrants further investigation is that made by the National Marine Fisheries Service to consider the transfer of the fishing fleet to Stage Harbor in Chatham. Finally, there needs to be a Section 7 consultation under the Endangered Species Act for turtles including the Kemp's Ridley turtle (Lepidochelys kempi), the Leatherback turtle (Dermochelys coriacea), the green sea turtle (Chelonia mydas) and the Loggerhead turtle (Caretta catretta).

We appreciate the opportunity to comment on this project proposal. Please keep us advised of the progress of this project. For further coordination, please contact Melvin P. Holmes of my staff at 617 565-4433.

Sincerely,

Edward L Reiner Acting for

Douglas A. Thompson, Chief
Wetland Protection Section

cc: NMFS, Gloucester, MA
F&WS, Concord, NH
MA DEP Wetlands, Woburn, MA
MA DWPC, Boston, MA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Region
Habitat and Protected Resources
Division
One Blackburn Drive
Gloucester, MA 01930-2298

July 25, 1991

Joseph L. Ignazio
Director of Planning
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Ignazio:

This responds to your letter of February 11, 1991, requesting comments on the COE navigation improvement study (107) for Aunt Lydia's Cove in Chatham, MA. Nancy Haley of our staff attended a formal site visit/meeting on May 20, 1991, to discuss the economically viable alternatives for this study. As detailed in the following comments, we find that the option to dredge a federal navigation channel in Chatham Harbor will have greater economic costs and continuous impacts to the environment than the option to transfer the fleet to Stage Harbor in Chatham, MA.

As you stated, a scoping meeting with other agencies and concerned parties was held in December, 1990, at which time a list of six practical alternatives was developed. By May 20th the list of economically viable alternatives had decreased to three possibilities:

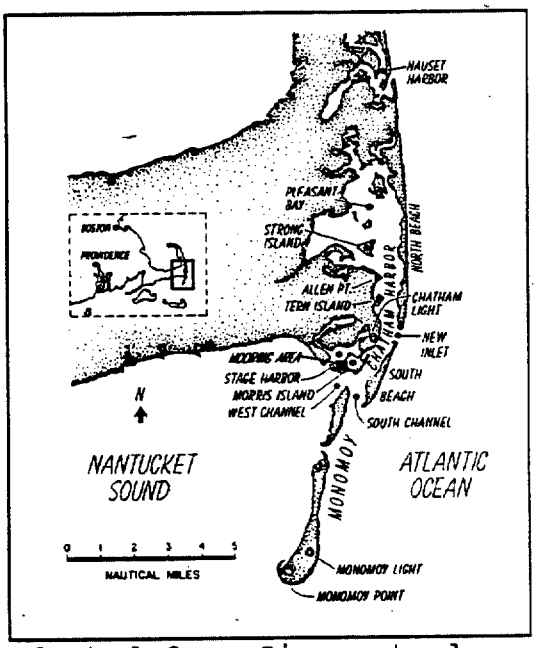
Plan A - Dredge a 6-foot channel south of Tern Island and maintain the Aunt Lydia's Cove Anchorage;

Plan B - Dredge a 6-foot channel around the north end of Tern Island and maintain the Aunt Lydia's Cove Anchorage;

Plan C - Dredge a 6-foot channel south of Tern Island, maintain the Aunt Lydia's Cove Anchorage, and construct a 900-foot rubblemound jetty just south of the Anchorage

An additional alternative mentioned in your letter (but omitted from this list) was the option of transferring the fishing fleet to Stage Harbor in Chatham. Since Stage Harbor is already maintained by a Corps navigational dredging project, the need to allocate federal funds for this option is negated. Some of the difficulties associated with this option include additional sailing time for the fishermen, the need for a sufficient mooring area, and lack of an offloading site. In view of this we recommend that this alternative be included in your analysis of

project alternatives as it may prove less costly over the long run and involve less damaging environmental impacts than any of the dredging proposals presented. To adequately evaluate this option, we suggest that you investigate the possibility of creating a mooring area in the region depicted in the figure (see Mooring Area) as well as pursue the construction of a docking area for the fishermen to offload their catch. A year-round mooring area is needed because there is a waiting list for space during the summer months.



Adapted from Giese et al., 1989

Dredging alternatives A, B, and C involve the removal of a substantial amount of sediments per year. Although the exact figures are not available because the system is so dynamic, early estimates predict that 25,000 to 40,000 cy of sand would need to be dredged, possibly two to three times a year. Chatham Harbor is a region of high ecological value. Pleasant Bay is designated as an Area of Critical Environmental Concern (ACEC) and the Nauset Beach barrier system is federally protected under the Cape Cod National Seashore. The proposed dredging project would have significant direct and indirect consequences on the natural environment of the harbor. Valuable commercial and sport fish species spend critical life stages in the harbor and adjacent Pleasant Bay. The area is rich in shellfish resources which are harvested for commercial and research purposes and which also serve as food for a variety of demersal finfish and shorebird species. The accretion of sand in the area as a result of the breach is known to have had a detrimental effect on shellfish species including soft-shell clams and blue mussels. However, any deliberate modifications to the breach as well as adjacent areas could exacerbate this problem instead of allowing natural sediment transport processes to evolve to an equilibrium state as they have following past breaches.

Studies conducted on Chatham Harbor over the past century have revealed the existence of a long-term cycle of geomorphological change in this barrier beach system which ultimately climaxes with the formation of a new inlet every 150 years (Geise et al., 1989). Based on this data, geologists are able to foresee future changes to this system. Their predictions, which assume that no alterations are imposed on the Chatham Harbor environment, show

that Tern Island will eventually connect to the mainland via the southern end at some point in this decade. Based on this information, it appears that dredging a channel around the northern end of the island, as is described in Plan B, would seem to least affect natural consequences of the breach on the Chatham Harbor environment. Conversely, maintaining a federal navigation channel to the south of Tern Island, as described in Plan A, will dramatically alter natural physical and geological cycles.

Plan C is extremely costly and would have to be evaluated in more detail before a recommendation could be made. A jetty in Chatham Harbor would most likely make the region even more difficult to manage. Jetties create new sets of secondary impacts and may in fact magnify the effect of such adverse processes as erosion and shoaling.

The COE seems to prefer a solution closely related to Plan A. This alternative would initially require the least amount of dredging. However, to properly maintain a navigation channel in this region, which is constantly burdened with dynamic channel shoaling and increased wave and tidal action, dredging will be necessary on a year-round basis. The Corps should assess both the cost and environmental consequences of this option to account for such maintenance requirements.

The disposal option for the three alternatives involves pumping dredged material through a pipeline onto Tern Island. The southern end of Tern Island is the preferred site for disposal since it is currently suffering from erosion. By enlarging the sand flats on the island, it is anticipated that the area will be colonized by invertebrates and that endangered shorebird species such as common terns or piping plovers will use this habitat as a nesting and breeding area. Continous beach nourishment and erosion will keep the area in artificial equilibrium, and might not support habitat for shellfish and shorebirds. Therefore, we recommend that you explore other sites for disposal such as North Beach or Lighthouse Beach.

Federally-listed endangered species include the Kemp's ridley turtle (Lepidochelys kempi), the leatherback turtle (Dermochelys coriacea), and the green sea turtle (Chelonia mydas). The green turtle is rarely seen in this area. The Kemp's ridley turtle prefers nearshore coastal areas where they forage for green crabs and mussels. Leatherbacks forage in open bay waters in search of jellyfish. Those three species have been sighted in Nantucket Sound, Cape Cod Bay, and in offshore Atlantic waters. A fourth turtle, the loggerhead (Caretta caretta), is currently listed as threatened. It typically feeds on benthic organisms found in larger bay systems. To date there have been no reports of sightings and/or strandings of any of these species in the Aunt Lydia's Cove region. However, the DEIS should still include a discussion of the potential impacts from dredging to these

species, especially if the dredge would be operating between July and October when juveniles of the listed species might wander into the inshore region. As such, this project will warrant a Section 7 consultation under the Endangered Species Act. For more information, contact Colleen Coogan at FTS 837-9291.

In the past few years there have been increasing numbers of harbor (Phoca vitulina) and grey seals (Halichoerus grypus) hauling out on the inner side of North Beach. This past winter roughly 300 seals were seen on the beach. These species are protected under the Marine Mammal Protection Act. If dredging were to occur while these animals were in the area, accidental harassment may result. The COE may want to consider applying for a small take exemption for harbor and grey seals under the MMPA. Section 3 (12) of the Act states "The term 'take' means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." For more information on this exemption, contact Doug Beach at FTS 837-9254.

In summary, the Chatham Harbor region is highly unstable and undergoing such dynamic changes that constant dredging seems futile. We recommend that the option to transfer the fleet to Stage Harbor be fully evaluated in the forthcoming draft environmental impact statement. Although fleet relocation may initially appear impractical, we believe that this one-time expenditure will be significantly less expensive over the long run than any of the dredging alternatives. In addition an alternatives analysis for an appropriate disposal site(s) for such a large magnitude of sediment would need to be conducted.

Please contact Nancy Haley at FTS 837-9388 if you have any questions regarding these comments.

Sincerely,

Chris Mantzaris
Habitat Program Coordinator

cc:
Peter Holmes, EPA, Boston, Ma.
US FWS, Concord, N.H.
MA DMF, Sandwich, Ma
CZM, Barnstable, Ma.
David Manskey, CCNS, Wellfleet, Ma.

References

Giese, Graham S., David G. Aubrey and James T. Liu 1989. Development, Characteristics, and Effects of the New Chatham Harbor Inlet. Woods Hole Oceanographic Institution Technical Publication, WHOI-89-19, 32 pp.

U.S. Army Corps of Engineers 1989. The Coastal Breach at Nauset Beach, Chatham, Massachusetts. Draft General Investigation Report, 265 pp.

Massachusetts Audubon Society

South Great Road
Lincoln, Massachusetts 01773
(617) 259-9500

July 12, 1991

Joseph Ignazio
Director of Planning
Corps of Engineers, NED
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

As requested by your staff, I am submitting comments concerning the Corps proposals at Aunt Lydia's Cove in Chatham. Laurie Martinelli, Director of Public Policy at the Society, and I attended the May 20 on-site in Chatham. The primary interest of the Massachusetts Audubon Society in this project concerns the use of our property, Tern Island, as a disposal site for dredge material.

Earlier in this century and up to about 1972, Tern Island was an important nesting area for Common and Roseate terns, the latter a state and federal listed endangered species. At other locations in Massachusetts the deposition of dredge material, when landscaped and planted appropriately, has proven attractive to Common and Least terns for nesting. Therefore, the Society has agreed to accept dredge material for Tern Island if the material is of a compatible grain size as existing sand and is located, landscaped, and planted as directed by the Society. An area of approximately six acres is available for this dredge material, representing a little over one-third of the area of the island above the mean high tide line.

On April 28, I discussed two methods of disposal being considered by the Army Corps with Cathy Demos. One proposal called for construction of a dike for temporary storage of dredge material. This procedure would provide no benefit to nesting terns and, in fact, would in effect remove six acres from use by birds and other wildlife. Because of these impacts, Massachusetts Audubon would adamantly oppose this option. The second suggestion was to utilize a permanent pipe with spigots to pump sand at various acceptable locations on the island. This alternative sounded feasible, but the Society would have to

carefully review the details of this proposal before it could comment on its merit. A third alternative, not discussed, is the use of a portion of Tern Island as an occasional dredge site location if and when the areas currently being used by the town of Chatham could hold additional dredge material (i.e., the general area used thus far has not been fully covered, or due to erosion could later be renourished). It is likely that this single procedure would also be acceptable, pending approval of a specific plan for each disposal project.

Lastly, an alternative plan only mentioned briefly at the May 20 meeting was to place dredge space on the intertidal zone of the island, in effect, increasing the island's size. This alternative may also prove beneficial to nesting terns and may be viewed favorably by the Society upon further review.

I look forward to our continued cooperation on this project. If you have questions, please call or write me.

Sincerely,

Scott Hecker

Scott Hecker, Coordinator
Coastal Waterbird Program

SH:cf
cc: L. Martinelli
R. Prescott
J. Benoit
B. Blodget
Chatham Conservation Commission

United States Department of the Interior
NATIONAL PARK SERVICE
CAPE COD NATIONAL SEASHORE
SOUTH WELLFLEET, MASSACHUSETTS 02663

IN REPLY REFER TO:

July 8, 1991

L1425

Mr. Joseph L. Ignazio
Director of Planning
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

Thank you for the opportunity to comment on the most recent alternatives being considered as part of the Navigation Improvement Feasibility Study at Aunt Lydia's Cove in Chatham. Although the proposed project is located outside the boundary of Cape Cod National Seashore, any modifications to Aunt Lydia's Cove could impact natural resources within lands we administer.

One of our concerns relates to the general lack of hydrologic data of the affected system and specifically what impacts will occur if any of the proposed alternatives are implemented. For example, how would sediment transport toward Pleasant Bay be affected by dredging and/or construction of a jetty? If sediment transport to the north was altered by such activities, we would not support the proposal, as resources within Cape Cod National Seashore could be impacted.

Another serious concern pertains to the absence of alternatives for the long-term disposal of dredge spoil. At a minimum, bi-annual dredging will be needed to maintain any of the proposed channels. No long-term plan has been presented for the disposal of this accumulated material. In a map handed out at the Interagency Coordination Meeting in Chatham on May 20, six potential disposal sites were identified, including one on Nauset Beach (North Beach), located within Cape Cod National Seashore.

We do not support any artificial beach nourishment within our boundary. This activity, like artificial structures constructed in dynamic coastal environments, disrupts natural processes and impacts habitats for beach plants and wildlife.

I hope that these comments are useful in your preparation of the draft action plan. If you need any additional information, please contact David Manski at 508/349-3785. Please continue to keep us apprised of developments on this project.

Thank you for your consideration.

Sincerely,

Anthony Bonanno
Acting Superintendent

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

COASTAL ZONE
MANAGEMENT

June 25, 1991

Mr. Joseph Ignazio
Director of Planning
Corps of Engineers, NED
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

As requested by your staff, I take this opportunity to provide you with comments on the ongoing study efforts at Aunt Lydia's Cove in Chatham.

As presented at the May 20 meeting in Chatham, the study alternatives of Aunt Lydia's Cove have been narrowed to three favorable plans. The following comments are offered to you on these alternatives to consider in your study recommendations.

1. 6' deep x 100' channel and anchorage at present location:
As discussed at the meeting, it appears that this is the most feasible from the Corps' economic analysis. Although the environmental analysis has not been completed, it appeared that this had the least impact on the bottom substrate, shellfish and other organisms.

2. Dredging North of Tern Island:
The analysis of the impact to the shellfish by dredging the tidal flats has not been completed, however, the impact seems to be far greater than that of alternative 1. Additionally, if there is to be a new channel dredged in this area, it is advised that hydraulic studies be conducted to determine the long-term stability of such a configuration.

3. Jetty on the south side of the fish pier with dredging of alternative #1:
This appears to be the least favorable alternative, given the dynamic nature of the area. Hydraulic analysis would be required to substantiate the use of a permanent structure in this environment. Further study would be required to ensure that the performance standards of the Wetlands Protection Act (310 CMR 10.27) were met in the construction of a jetty, such as having no adverse impacts by increasing erosion, or changing the form of a downdrift beach. Additionally, a sand by-pass scheme would probably need to be developed.

In terms of disposal, I am very much encouraged to see that the Corps is considering such a creative solution to maintenance dredging. Purchase of a dredge for yearly maintenance would probably be more efficient in the long run financially, as indicated by your staff. As you know, however, this would not alleviate the requirement to apply for permits at the local, state or federal level. As witnessed by many projects, dredge operation requires an experienced person to ensure that the job is done with minimal impacts to the environment and the daily operation of the harbor. It is presently unclear who would operate the dredge in the proposed scenario and what training would be available or provided.

Additionally, the ideas on utilizing Tern Island as a disposal site need to be further detailed. At the meeting, two alternatives of this proposal were discussed. The diking of the south side of the island would impact approximately 6 acres. As I understand it, this area would be used for de-watering and stockpiling until it reached capacity. This would appear to have long-term impacts since the area would always be a "construction site". The environmental impacts of this alternative need to be addressed in detail, considering that this is a resource area protected by state and local regulations. The second alternative, utilizing a permanent pipe with spigots to pump sand to various areas on the island, is another creative solution. However, many issues are still not understood. Is this a permanent solution for the 50 year project life, or is this just a "temporary" solution? What are the short-term and long-term impacts to the wildlife that utilize the dune areas? I am sure that discussions are ongoing with Audubon to discuss these potential impacts. I once again would refer you to the Wetlands Protection Act and the performance standards for the resource areas of the coastal beach and dune.

I look forward to continued cooperation on this project. Any questions or comments should be directed to Pam Rubinoff, the Cape Cod Regional Coordinator, at (508) 362-3828.

Sincerely,

Jeff Benoit
Director

JB:PR
cc: Cathy Demos, COE
Scott Hecker, Mass Audubon
Pam Rubinoff, MCZM Cape Cod Regional Coordinator

Chatham Shellfish Department

549 Main Street • Chatham, Mass. 02633
Telephone (508) 945-2331 • 945-2100

June 4, 1991

Army Corps of Engineers
Building 113N
424 Trapelo Road
Waltham MA 02254

ATTENTION: Ms. Cathy Demos

Gentlemen:

The following are shellfish catch reports recorded for the Town of Chatham for the years 1989-90 by the Shellfish Department. The figures are confined to include only Pleasant Bay/Chatham Harbor:

1989 -	Pleasant Bay	1,700 bu. scallops
	Chatham Harbor	30,000 bu. mussels
1990 -	Pleasant Bay	No scallops
	Chatham Harbor	110,000 bu. mussels

The 1989 scallop harvest occurred in Pleasant Bay in the area between Strong Island and Eastward Ho Country Club golf course. The mussel harvest in Chatham Harbor occurs in two distinct areas. One area is located south of the "break," below Morris Island. The boats that fish this bed access this area from Stage Harbor. The 1989 harvest of 30,000 bu. was derived entirely from this location. The other area is located in the upper end of Chatham Harbor, north of the "break" and is presently an extensive bed. Mussels are to be found virtually everywhere in this area. Of the 1990 harvest of 110,000 bu., approximately 30,000 bu. were harvested in this part of Chatham Harbor. Boats fishing here access the area from Ryder's Cove. The mussels north of the break seem to grow more slowly than those south of the break. Consequently they did not achieve a harvestable size as early as the mussels south of the break (the Town of Chatham has a 2-inch size limit on mussels). Fishing this area presents more problems to the fishermen than the Morris Island area due to increased tidal flow in this part of Chatham Harbor.

With regard to the three proposals for the fish pier, I would make the following comments: Plan A (continual dredging of channel and anchorage) implies the least environmental impact. Plan B (dredging around the north end of Tern Island) is a tremendous dredging project. In terms of shellfish involvement, I can only say that there are extensive mussel beds in the area. Without an engineered plan deliniating routes, depths, disposal areas, etc., I can make no projections regarding potential impact on existing shellfish beds. I have to think, however, that shellfish would be a consideration here. Plan C (a jetty) poses some interesting speculation on my part. There is presently a mussel bed "uptide" of the proposed location of the jetty. This bed appears to be sanding over. It is my opinion that a jetty here would perhaps hasten this process due to retention of sediment uptide of the jetty. However, this in turn could create a new flat that would perhaps in time stabilize and become a more hospitable environment for other shellfish species. Given the current dynamics of the area, it is really impossible to predict anything with any certainty. In terms of water quality in the fish pier basin, Plan C is much more attractive than Plan B. Plan B would result in the eventual closing off of the southern end of the basin with resultant loss of tidal flushing and possible creation of a somewhat stagnant situation in the basin itself.

Please contact me if you feel the need for further explanation of any of the information that I have included. I am keenly interested in this project and I sincerely hope that it can be resolved in such a manner as to benefit the Town of Chatham.

Very truly yours,

Stuart Moore

Stuart Moore
Shellfish Constable

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

29 May 1991

In reply, please refer to
NHESP File:91-63

Joseph L. Ignazio
Planning Directorate
Impact Analysis Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Re: Aunt Lydia's Cove Navigation Improvement Study
Chatham

Dear Mr Ignazio:

Thank you for contacting the Natural Heritage and Endangered Species Program of the Division of Fisheries and Wildlife regarding the project referred to above. We have reviewed the options discussed in your letter of 11 February 1991 and would like to offer the following comments.

The disposal of dredged material, if conducted properly and at the right location, has the potential of improving or creating nesting sites for terns and plovers. If there is a need to dispose of dredge material we would recommend Tern Island or North Beach as the disposal site, in that order. Disposal on Tern Island could benefit Common Terns (*Sterna hirundo*) and Roseate Terns (*Sterna dougallii*), which are state-listed as Special Concern species and Endangered Species, respectively. The Roseate Tern is also federally listed as Endangered. Disposal on North Beach would more likely benefit Piping Plovers (*Charadrius melodus*), which is state- and federally-listed as Threatened.

Tern Island was a disposal site in 1990, but it is our understanding that the results of this work were not satisfactory. The area where the dredged materials were deposited was not graded to contours that would serve as suitable nesting substrate. Provisions should be made to properly grade the deposits of last summer and any future deposits if there is going to be any benefit to nesting shorebirds.

Natural Heritage & Endangered Species Program
100 Cambridge Street, Boston, MA 02202 (617) 727-9194, (617) 727-3151
An Agency of the Department of Fisheries, Wildlife & Environmental Law Enforcement

We strongly discourage the construction of a breakwater connecting Tern Island with the mainland. Such a structure could provide additional access to the island for people and predators and would significantly diminish the value of the island as a shorebird nesting site.

Any activities which would affect Tern Island should also be discussed and coordinated with the Massachusetts Audubon Society, which owns and maintains the island as a sanctuary. We suggest contacting Scott Hecker at (617) 259-9500.

We would discourage disposal on mainland beaches. This could entice terns or plovers to nest in areas frequented by people and predators, and thus result in wasted breeding effort. It would be much better to dispose of materials in areas where nesting birds would be relatively safe from these other threats, such as Tern Island or North Beach. The other subtidal and intertidal disposal sites discussed in your letter would have no effect on tern and plover nesting, positive or negative.

We note that South Beach Island was not among the list of potential sites. In our opinion South Beach Island could also be a good site for improving tern and plover nesting habitat and should be considered as an option as well.

Please note that this evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. Should project plans change, or new rare species information become available, this evaluation may have to be reconsidered.

If you have any further questions please call Brad Blodgett at (508) 366-4479.

Sincerely,

Jay Copeland
Environmental Reviewer

JC/jc

TOWN OF CHATHAM INCORPORATED JUNE 11 1712 MASS.

Town of Chatham

Conservation Commission

March 1, 1991

Joseph L. Ignazio
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

Dear Mr. Ignazio;

Thank you for your letter of February 11, 1991.

Regarding the alternatives outlined, the Conservation Commission feels that presently there is not enough information to weigh the environmental issues involved in the options.

Sincerely,

Douglas B. Wells, I.

Douglas B. Wells, Chairman

DBW/j

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
CAPE COD NATIONAL SEASHORE
SOUTH WELLFLEET, MASSACHUSETTS 02663

February 27, 1991

L1425

Office of the Secretary
Executive Office of
Environmental Affairs
Twentieth Floor
100 Cambridge Street
Boston, MA 02202

Attention: MEPA Unit
EOEA #7217 (Aunt Lydia's Cove Navigation Study)

Gentlemen:

We have reviewed the proposed plans for Aunt Lydia's Cove and request that the following comments be considered.

Any federal actions will potentially impact the federally threatened Piping Plover and consultation with the USFWS under Section 7 of the Endangered Species Act may be required. Additional consultation between the town and the Massachusetts Division of Fisheries and Wildlife may also be required under the Massachusetts Endangered Species Act.

Stage Harbor is already maintained at federal expense as a harbor of refuge. The addition of another dredging project so nearby does not seem like efficient use of federal funds. The establishment of a dredge channel through the breach is in fact a modification of the breach, contrary to the statement on page two of the letter which states: "Alternatives which will not be evaluated in-depth include actions which would alter the breach...".

We do not support the use of artificial structures of any kind to alter sand migration (alternatives 4, 5 and 6). Such structures always result in a disruption of the natural processes and impact the habitats for beach plants and wildlife. The area potentially affected by such structures was not clear from the descriptions received.

A special request was made on page two to identify known natural resources in the area. In addition to the Piping Plover listed above, there are a number of other species of interest to consider. Tern Island was historically a very important regional tern colony. The island has not been used by nesting terns for several years, and the Massachusetts Division of Fisheries and Wildlife will be able to provide more information on these populations.

Other state-listed wildlife includes Northern Harriers, which nest on South Beach Island; Short-eared Owls, which nest on Monomoy Island and could potentially nest on South Beach Island or North Beach; and the presence of an important high-tide roosting area for migrant shorebirds on the southern half of South Beach Island. The federally threatened northeastern beach tiger beetle is historically known from North Beach. To our knowledge, no field work for rare plants has been made on the beaches of Chatham.

We hope that this information is responsive to the concerns stated above. If you need any additional information, please feel free to contact me or Kyle Jones at 508-487-2100.

Sincerely,

Andrew T. Ringgold

Andrew T. Ringgold
Superintendent

cc: David Clark, Chief Environmental Planning, NARO
Joseph L. Ignazio, Dir. of Planning, Dept. of the Army, New England Div., Corps of Engineers, 424 Trapelo Road Waltham, MA 02254-9149

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

May 25, 1989

Joseph Ignazio, Chief
Planning Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

Dear Mr. Ignazio:

This planning aid letter provides a description of fish and wildlife resources and a preliminary assessment of environmental concerns related to the New England Division's reconnaissance study of the breach in the Nauset Beach coastal barrier at Chatham, Massachusetts (Chatham Breach). It has been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq., 48 Stat. 401, as amended).

It is our understanding that the Corps is investigating alternatives to relieve navigation and shoreline erosion problems resulting from the natural barrier beach breach that formed a new inlet and isolated the southern tip of Nauset Beach (now called South Beach Island). We understand the three primary navigation components of the study are: dredging an anchorage for the commercial fishing fleet at Aunt Lydia's Cove; dredging a navigation channel from the Town Fish Pier southeast through Chatham Harbor to provide boat access through the new inlet; and construction of a bulkhead or wave fence at the south end of Tern Island or in the shoal area east of the Fish Pier. The new anchorage would encompass approximately 11 acres between Tern Island and the Chatham mainland. Beginning at the Fish Pier, the navigation channel would start out at 100 feet wide and 7 feet deep for 800 linear feet, increase to 150 feet wide/9 feet deep for 2000 feet, then increase to 200 feet wide/13 feet deep for a total length of approximately one mile. Specific details on the wave fence/breakwater were not provided.

We understand the three alternatives for shoreline protection under consideration are: sand fill using dredged material from the navigation improvement project, a revetment, and a Construction Product and Research (CPAR) alternative that would use three rows of portable, prism-shaped structures placed parallel to the beach. All three alternatives are intended for a 1200-foot section of beach at Andrew Hardings Lane that has experienced significant erosion since the breach opened in 1987.

Also being considered is a long-term monitoring program aimed at collecting wave, wind, current, and sediment transport data in an attempt to document and more accurately predict changes in local coastal barrier conditions.

Chatham is protected by a system of barrier beaches and islands formed by two littoral drift systems. Included in this coastal barrier system is Monomoy National Wildlife Refuge, consisting of North and South Monomoy Islands (Monomoy), as well as 40 acres on Morris Island. The natural breaching of the

Nauset Beach barrier spit represents a recurring phase in a cyclical pattern of barrier beach changes in the Chatham vicinity. This pattern has been described by coastal experts based on historic shoreline configuration data from the past 200 years. Based on these patterns, predictions of expected future changes in the Chatham barrier beach system have been made. It is believed that the newly formed inlet at Chatham will continue to migrate to the south as sand is deposited at the southern tip of the Nauset Beach spit (North Beach) and the spit rebuilds towards the south. It is expected that the newly formed South Beach Island will experience additional breaching due to the interruption of sediment transport from the north. As in the past, the island will likely breakup and disintegrate over time, exposing the Chatham mainland again to the direct force of the Atlantic Ocean. Material from South Beach Island will be transported to the south and west, and it is likely that Monomoy will again become a peninsula as it is reconnected to the mainland.

Efforts to alter natural processes that shape the coastal barrier system could have widespread land use, resource management, and environmental implications, potentially extending from Cape Cod National Seashore to Monomoy and into Nantucket Sound. Any proposal to permanently modify the coastal barrier system would be considered a major Federal action significantly affecting the human environment (40 CFR 1502.3), and as such would require the preparation of an environmental impact statement pursuant to National Environmental Policy Act regulations (40 CFR 1500-1508). We would expect the environmental impact statement for such a project to not be limited to an evaluation of specific navigation or shoreline project features, but to also consider expected long-term changes in the coastal barrier system and the implications of those changes on coastal development and resource management.

Resources of the Project Vicinity

The proposed project lies within Pleasant Bay, a large estuarine embayment on the southeastern corner of Cape Cod. Pleasant Bay extends north and south some 10 miles, encompassing the towns of Brewster, Chatham, Orleans, and Harwich. It is one of the larger estuaries on the Massachusetts Coast, with a surface area of approximately 7000 acres. The Pleasant Bay system possesses outstanding natural resource attributes including: approximately 1200 acres of saltmarsh, thousands of acres of tidal flats, an extensive system of largely unaltered barrier beaches and islands, numerous fresh and saltwater ponds, and significant estuarine habitat. The estuary supports a diverse assemblage of fish and wildlife resources. Because of their relatively unaltered state, Pleasant Bay's marshes, tidal flats, and coastal barriers function at their full capacity as breeding, migration, and wintering habitat for wildlife, and spawning and nursery habitat for fishery resources. In order to recognize and protect the outstanding natural resources of Pleasant Bay, that portion of the Bay north of Allen Point was designated an Area of Critical Environmental Concern (ACEC) in 1987 under the Massachusetts Coastal Zone Management program.

Wetlands

Of the approximately 1200 acres of saltmarsh within Pleasant Bay, about 400 acres occur within the Town of Chatham. Typical salt marsh species include salt meadow hay, saltmarsh cord grass, salt grass, glasswort, black rush, and sea blight. Beach grass is common on sand dunes in the area. Eel grass, sea

lettuce and rockweed occur in tide channels and on tidal flats. There is a small (about 2 acre) palustrine shrub-scrub wetland directly adjacent to the beach at Andrew Hardings Lane in Chatham. This wetland could be affected by proposed beach stabilization measures. Wetland plants here include willow, alder, red-osier dogwood, honeysuckle, sensitive fern, and Japanese knotweed.

Fishery Resources

Pleasant Bay supports significant marine finfish and shellfish resources. Species normally associated with more saline marine waters are found throughout the estuary as salinities are relatively high due to the limited amount of dilution from freshwater inflow. The most abundant estuarine species found within Pleasant Bay are: Atlantic silversides, mummichog, striped killifish, sticklebacks and northern pipefish. Among the important commercial and recreationally important fish species occurring within the Bay are: winter flounder, tautog, white hake, scup, Atlantic tomcod, and American eel. Striped bass and alewives are the two anadromous species found in the study area.

Pleasant Bay is one of the most productive marine sportfishing areas along the Massachusetts coast due to the abundance of baitfish. Among the species targeted by the sport fishery are striped bass, bluefish, pollock, tautog, cod, winter flounder, scup, and tomcod. There is a significant commercial fishery for ground fish outside the Bay that are landed at the Chatham Fish Pier. Commercial species landed at Chatham include Atlantic cod, haddock, pollock, hake, halibut, winter and yellowtail flounder, and ocean perch.

In addition to finfish, Pleasant Bay also supports significant shellfish resources. Quahogs constitute the major shellfish resource and, along with scallops, are harvested both commercially and recreationally. Soft-shelled clams, mussels, razor clams, and conch are also found within Pleasant Bay. There is a limited fishery for lobster. Horseshoe and blue crabs are present. Intertidal flats within the estuary also support many species of marine worms, amphipods, and crustaceans that are a vital food source for shorebirds, waterfowl, seabirds, and fishery resources.

It has been reported that shoaling from the recent breach has covered some of the productive shellfish beds in Chatham Harbor. Shellfish have undoubtedly been subjected to sedimentation impacts from natural coastal changes in the past. While periodic fluctuations in Pleasant Bay shellfish populations have been recorded, they have not specifically been linked with coastal barrier changes. We would expect areas impacted by sediment deposition from the breach to eventually recover over time as they are colonized by spat from healthy shellfish beds in unaffected portions of the Bay.

Wildlife Resources

Mammalian residents of the barrier islands and beaches are primarily small animals such as shrews, mice and voles. Several species of bats are found in the area. Larger mammals are known primarily because of their predation on bird nests and include red fox, raccoon, skunk, and weasel. White-tail deer are found on both the mainland and Monomoy. Harbor and gray seals can be found in the waters around Chatham Harbor. The largest aggregation of harbor seals at a single winter haulout site was reported at Monomoy, where an average of approximately one thousand seals are known to winter. Harbor seal pupping has also been recorded on Monomoy.

Wildlife resources in the project vicinity are dominated by birds. Surveys of South Beach Island have documented 47 species of birds, with 10 species confirmed as breeding on the island. Northern harriers and short-eared owls have been observed on South Beach Island, and are known to nest on Monomoy. The northern harrier is listed as threatened in Massachusetts, while the short-eared owl is on the Commonwealth's endangered list. Sharp-shinned and Cooper's hawks have also been reported in the project vicinity. The bald eagle and peregrine falcon, both Federally listed as endangered, have been seen in the area during the spring and fall migration and during winter bird counts.

The freshwater ponds and protected estuarine waters of Pleasant Bay and its environs are important migratory stop-over and wintering habitat for waterfowl. Pleasant Bay is a critical wintering area for American black duck and Canada goose. Other species observed during midwinter waterfowl counts are mallard, merganser, bufflehead, goldeneye, scaup, eider, oldsquaw, scoter, and brant. The largest variety of breeding waterfowl in Massachusetts is found on barrier islands in the area, including Monomoy. They include: mallard, American black duck, Canada goose, gadwall, green-winged teal, ruddy duck, American widgeon, northern pintail, northern shoveler, blue-winged teal, and red-breasted merganser. American black duck and Canada goose nest on South Beach Island.

Shorebirds are perhaps the most significant bird resources of the project vicinity. The extensive intertidal flats within Pleasant Bay, in particular along the west side of Nauset Beach, South Beach Island, and Monomoy, provide critical feeding and resting habitat for large migratory shorebird concentrations. Among the migratory species observed in the project area are: black-bellied plover, semipalmated plover, greater and lesser yellowlegs, whimbrel, Hudsonian godwit, marbled godwit, ruddy turnstone, red knot, sanderling, short-billed dowitcher, and several species of sandpiper. Nesting shorebird species include the American oystercatcher, willet, spotted sandpiper, and piping plover, Federally listed as threatened along the Atlantic coast. Five pair of piping plover nested on South Beach Island in 1987, however, no young were fledged due to nest predation. Three pair nested in 1988, fledging three chicks. Three pair of piping plover nested here in 1989.

Pleasant Bay and its adjacent barrier beaches are used for feeding, loafing and courtship by common, arctic, least, and the Federally listed endangered roseate tern. The new inlet through the barrier beach is a productive feeding area for terns. Least terns have established nesting colonies on South Beach Island, but like the piping plover, were not successful due to mammalian predation and nest loss from high tide overwash. Common tern colonies in the Nauset Beach area have been increasing in size. Tern Island, a proposed dredged material disposal site, historically received extensive use by nesting terns, including roseate, common and arctic species. The nesting tern population peaked in the 1930's at approximately 15,000 pair and declined to zero by 1972. Predation by rats was blamed for the decline, however, the subsequent growth of dense vegetative cover presently makes Tern Island an unattractive nesting site for terns and piping plover.

Wading birds such as snowy egret, black-crowned night heron, great blue heron, and glossy ibis can be found on barrier islands and tidal flats in the project vicinity. A variety of passerine species nest in the area. The barrier islands are important as resting stopovers for numerous land bird species, especially during the fall migration.

Environmental Concerns

Our overriding concern with both the navigation and beach stabilization components of the reconnaissance study is the potential for adverse impacts to natural coastal barrier evolution and ecosystem adaptation/recovery processes within Pleasant Bay and the adjacent coastal barrier system, including Monomoy National Wildlife Refuge. Pleasant Bay and the surrounding coastal environment has been subjected to cyclical patterns of coastal change for hundreds of years. While such changes may cause shifts in fish and wildlife distribution patterns, we expect impacted resources to gradually recover as naturally disturbed areas become recolonized and conditions stabilize. It will be difficult to predict the effects of proposed dredging and beach stabilization measures on fish and wildlife resources, since biological conditions are constantly evolving in response to natural changes in the coastal environment.

Navigation

Creation and maintenance of a Federal navigation channel through the breach would appear to be problematic, given the shifting nature of the new inlet and the large sediment load associated with littoral drift in the project vicinity. Attempts to stabilize or enlarge the new inlet at Chatham by dredging could affect shoreline erosion on the mainland, sediment transport and deposition, and tidal circulation patterns. These project-induced changes could in turn have wide-reaching affects on fish and wildlife resources.

We question whether it is possible to accurately predict what navigation measures will be called for in the future, due to the active transport dynamics of the area and the lack of definitive modeling capabilities. Although jetties are not proposed in this reconnaissance study, we are concerned that once a Federal navigation channel is declared, structural measures such as jetties may be called for in the future to maintain the entrance channel. Any attempt to permanently modify the coastal barrier system to provide a navigation inlet would likely be met with a great deal of controversy. We would object to construction of any permanent structural navigation features that would alter the coastal barrier system.

If the project proceeds to the feasibility phase, we recommend that studies be performed to assess the impact of maintaining a navigation channel through the new inlet on beach erosion, sediment transport, and tidal circulation patterns within Pleasant Bay and the adjacent barrier beach system. Predicted changes in the physical environment should then be related to changes in biotic communities. We are particularly concerned with the potential for long-term changes in the littoral sediment supply to Monomoy National Wildlife Refuge, especially in the event that structural measures such as jetties are required in the future to maintain the channel entrance. In addition to affecting fish and wildlife habitat conditions, changes in the deposition and

erosion of sand at Monomoy may also have land management and ownership implications as the islands merge with the mainland or with other islands. Such implications should be evaluated during the feasibility study. Alternatives to dredging through the breach should also be investigated, e.g., dredging only within Pleasant Bay or relocation of the Town Fish Pier.

It will be difficult to accurately assess impacts of navigation channel dredging since environmental conditions in Chatham Harbor are in a state of flux, making it difficult to establish baseline conditions. Impacts may differ in the future, depending on the level of resource recovery that has occurred at the time of dredging. Site specific surveys should be conducted throughout the feasibility study phase to determine existing resource conditions in project-affected areas.

Dredging of the 11-acre anchorage between Tern Island and the Town Fish Pier could impact estuarine wetlands and intertidal flats that are important for shorebirds, waterfowl and other wildlife resources. At this time, the extent of wetland and intertidal habitat impacts associated with the anchorage has not been defined. If the project proceeds to the feasibility phase, we recommend that detailed investigations be completed to identify benthic, vegetative, fishery and other wildlife resources of the proposed dredging areas. Information on the characteristics and stability of sediments underlying the dredging areas should be obtained to assess disposal options and to evaluate the long-term stability of the anchorage area (i.e., will the sides of the dredged basin collapse, with resultant impacts to adjacent saltmarsh). This information should be used to develop alternatives which minimize or eliminate resource impacts.

Only limited comments on the effects of wave fences or breakwaters in Chatham Harbor can be provided since specific information on these project features is lacking. A rubble mound-type breakwater would have the most severe impacts on fish and wildlife resources, since benthic habitat would be permanently covered and the structure would presumably have a substantial "footprint". This type of structure would not seem well suited to Chatham Harbor since expected changes in shoal and inlet configuration may redirect wave patterns in the future. Floating or portable breakwater structures may have less habitat impacts, depending on their design, and could be realigned or removed as wave and current conditions change. Additional impact evaluation will be required during the feasibility study to assess the effects of wave fence or breakwater alternatives.

Dredge Disposal

Although it is estimated that only 50,000 cubic yards of material would be dredged in the initial navigation improvement project based on present conditions, dredging quantities may significantly change during the planning process due to active littoral transport in the project area. We would also expect that significant volumes of material could accompany maintenance dredging over the project life. Estimates of maintenance dredging requirements and development of a long-term dredge material disposal strategy will be important components of feasibility phase studies.

Fortunately, opportunities exist for the beneficial use of dredged material. A number of conservation groups and resource agencies are interested in using dredged material for enhancing tern and plover nesting habitat on Tern Island. Piping plover and least tern both prefer to nest on newly deposited sandy material. As sand deposits are colonized by beach grass and other herbaceous

plants, common and roseate terns may be induced to initiate nesting. Two important considerations for dredged material disposal are: timing the work to avoid the critical nesting period; and containing the material within the disposal site to prevent encroachment on adjacent wetlands. Specific plans for disposal on Tern Island to enhance plover and tern nesting habitat should be developed during the feasibility study.

Three other potential dredge material disposal sites have been identified: Allen Point, the northeastern portion of South Beach Island, and the beach erosion site at Andrew Hardings Lane. Disposal at Allen Point would require additional investigation of the potential for impacts to the Pleasant Bay Area of Critical Environmental Concern (ACEC). Disposal at the South Beach Island site could have both beneficial and negative impacts on the threatened piping plover. Beach disposal of dredged material could enhance plover nesting habitat. However, disposal during the nesting period could disturb plovers already nesting on South Beach Island. Disposal should occur between September 1 and March 1 to avoid disturbance during the nesting and fledging period. If disposal were to occur within the nesting period, nest territories would have to be identified prior to project commencement and disposal activities confined to areas at least 300 feet away from identified territories.

Based on existing conditions, we would not expect significant on-site resource impacts from disposal at Andrew Hardings Lane beach, since benthic resources have reportedly been impacted by recent erosion/depositional events. However, as we mentioned before, it is likely that baseline biological conditions will change during the planning process, necessitating site specific resource surveys before dredge disposal impacts can be quantified. The potential for off-site impacts is also of concern, since it has been shown that sand deposited at this site is transported to other areas. The ultimate fate of sand deposited here and the resultant resource impacts should be examined in the feasibility study.

Shoreline Protection

Impacts associated with the CPAR alternative are difficult to determine since little specific information was provided, however, we believe this option should be studied in more detail. Impacts would presumably not be permanent, as the prism-shaped structures would be portable, and could be moved as the zone of beach erosion caused by the breach changes in response to shifts in the location of the inlet. The temporary/portable feature of this alternative is important, since the localized shoreline erosion problem will probably change as the Nauset Beach barrier spit gradually reforms and South Beach Island breaks up. Once the threat of erosion has passed, the structures could be removed. The research orientation of this option would provide useful data for addressing future erosion problems that may develop as the configuration of coastal barriers continues to change.

We would expect the revetment option to have the greatest resource impacts of the three options under consideration. Impacts from the footprint of the structure would be permanent. Habitat types affected by the structure could include intertidal flats, coastal dunes, freshwater wetlands and/or uplands, depending on the final location for the structure. An important issue to be considered during the feasibility phase would be the effect of the structure on adjacent unprotected shorelines. As the focus of wave energy through the new inlet changes over time, the revetment may need to be repeatedly extended to prevent it from being washed out around the ends. The original revetment may eventually become dysfunctional as coastal conditions change.

Based on existing conditions, we would not expect significant on-site resource impacts from sand fill at Andrew Hardings Lane beach, since benthic resources have reportedly been impacted by recent erosion/depositional events. However, as we mentioned before, it is likely that baseline biological conditions will change during the planning process. The current status of shellfish populations and other benthic resources in project-affected areas will need to be confirmed during the feasibility study, before a final evaluation of dredge disposal impacts can be completed.

There may also be off-site impacts from the transport and subsequent deposition of fill material elsewhere in Pleasant Bay. During the feasibility study, we recommend that sediment transport modeling be performed to assess the fate of sand deposited at this site. The resource implications of such transport and deposition should be examined. If beach nourishment at Andrew Hardings Lane is selected as the preferred disposal option, it would preclude enhancement of tern and plover nesting habitat on Tern Island.

Summary

This reconnaissance study considers several alternatives to alleviate navigation and shoreline erosion problems caused by the January 2, 1987, breaching of the Nauset Beach barrier spit and subsequent creation of a new inlet connecting the Atlantic Ocean and Pleasant Bay. Pleasant Bay is one of the larger estuaries on the coast of Massachusetts and is formed by a system of active barrier beaches and islands. Pleasant Bay and its associated coastal barriers support an outstanding assemblage of fish and wildlife resources, including estuarine and freshwater wetlands, sport and commercial fisheries, shellfish, waterfowl, shorebirds, raptors, and marine mammals.

Recent changes in the coastal barrier system that prompted this reconnaissance study are part of a cyclical pattern of coastal deposition and erosion processes that are believed to have a recurrence interval of about 150 years. Based on the tremendous scale of these coastal processes, there does not appear to be anything that can be done to stop the natural progression of coastal evolution. Human efforts to alter natural coastal processes will likely be unsuccessful in achieving the desired protection, but may have wide ranging impacts on the natural environment.

To facilitate navigation through the new inlet, the creation and subsequent maintenance of a navigation channel from the Town Fish Pier in Chatham through the inlet to the open ocean is being considered. An overriding concern with such a proposal would be the affect of artificially maintaining the inlet on natural littoral transport and coastal barrier development, and resultant impacts on fish and wildlife resources. We are concerned that once a Federal navigation channel is declared, more drastic measures, such as entrance jetties, may be required in the future to maintain the inlet. Construction of structural navigation features could have significant implications with respect to the Coastal Zone Management Act, Coastal Barriers Resources Act and Federal land management on Cape Cod National Seashore and Monomoy National Wildlife Refuge. These issues should be explored in detail during the feasibility study phase. We also recommend that alternatives to the proposed actions be fully evaluated. Among the alternatives that should be considered are dredging only within Pleasant Harbor and not through the breach, and relocation of the commercial fishing fleet at Aunt Lydia's Cove in anticipation of future coastal changes that may further impede navigation in the project area.

Dredging an 11-acre anchorage adjacent to Tern Island could adversely impact salt marsh, productive tide flats, or subtidal sea grass beds. Site specific surveys of habitat conditions within all areas affected by the project should be a part of the feasibility study. Alternatives to avoid resource impacts should be thoroughly evaluated.

A comprehensive plan for dredged material management over the life of the project should be developed. Tern Island appears to be a desirable disposal site, since nesting habitat for the piping plover and several tern species could be enhanced. The capacity of the island for accommodating dredged material should be evaluated in the feasibility study. Plover nesting habitat could also be enhanced at the South Beach Island disposal site, provided the work could be scheduled to avoid impacts to plovers already using the beach. Impacts from disposal at the other two beach nourishment sites will require further study to determine fish and wildlife impacts.

Construction of a revetment to control shoreline erosion could permanently impact intertidal habitat, coastal dunes, uplands, or freshwater wetlands, depending on the final location of the structure. The long-term affect of a revetment on coastal erosion and deposition should be examined as part of the feasibility study. The physical extent of impacts and the need for additional shoreline armoring in the future should also be examined.

We are uncertain what the actual impacts of the CPAR alternative would be, and recommend that it be further investigated. The portable characteristic of this option would seem to lend itself to the shifting nature of the erosion problem. It is also our understanding that the structures could be easily removed once the erosion threat has passed. The research orientation of this alternative would hopefully provide useful information to address future shoreline erosion problems.

Non-structural measures were not specifically mentioned in our coordination with the Corps planning staff, however, we recommend that they be investigated in future studies for this project. The Housing and Community Development Act of 1987 is particularly applicable to this project, as it contains a new insurance plan for coastal homeowners faced with loosing their home to erosion. Section 544 of the Act, also known as the Upton-Jones Amendment, is meant to encourage property owners to relocate erosion-threatened structures before they are destroyed. We understand the new insurance plan also grants participants in the National Flood Insurance Program options that allow for houses that cannot be saved to be levelled at a safe time and threatened houses to be moved prior to being damaged. This new program may have widespread application for homeowners along the Chatham mainland, given the potential for the eventual disintegration of South Beach Island and re-exposure of the mainland to the Atlantic Ocean.

Non-structural solutions for reducing flood damage in the study area would best accommodate natural patterns in coastal barrier change. Based on projections by coastal experts, the present situation at Chatham is likely to change drastically, as it has in the past, and a much larger area could be affected. Development will eventually be forced to pull back from the waters edge in response to natural coastal changes. Non-structural measures would allow erosion-prone structures to be relocated at a gradual pace to keep up with coastal barrier changes and rising sea level. Implementing structural protection measures would not only postpone the inevitable evacuation of coastal areas subject to increased wave action and sea level rise, they could make matters worse by supporting continued development within the coastal floodplain.

We would consider any effort to permanently alter the coastal barrier system at Chatham to constitute a major Federal action significantly affecting the quality of the human environment, thus requiring an environmental impact statement (EIS) pursuant to the National Environmental Policy Act. The scope of the EIS should be sufficiently broad to fully consider the complete cycle of coastal barrier change and the resultant implications to shoreline development and coastal resource management.

We believe the most prudent course of action at this time is implementation of the long-term monitoring plan. We understand this plan involves deployment of environmental monitoring equipment throughout the area to collect data which will aid in the development of long-range predictive models. When coupled with an early warning system and non-structural measures such as relocation and flood insurance, this option will allow natural coastal process to continue as they have in the past, while increasing our understanding of these changes on the natural and human environment.

We appreciate the opportunity to provide these planning aid comments. Please contact Mike Tehan of this office at 603-225-1411 if you have questions or comments.

Sincerely yours,

Vernon Lang
Acting Supervisor
New England Area

APPENDIX 1

ECONOMIC ASSESSMENT

ECONOMIC ASSESSMENT
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INTRODUCTION

The purpose of the economics section is to provide an economic evaluation of plans to improve navigation conditions in Aunt Lydia's Cove. This section describes the study area, the with project impact on the supply and demand for fish and resource status, and other conditions related to fishing such as Coast Guard operations and operations of the fish pier. Project benefit is evaluated in accordance with the Principles and Guidelines incorporated in ER 1105-2-100, Section IX,NED Benefit Evaluation Procedure: Commercial Fishing. Net benefits and benefit/cost ratios will be presented for plans under consideration. A plan must have a net benefit greater than 0 or a benefit cost ratio greater than 1 to be justified. The plan with the largest net benefit will be identified. The economic analysis is performed at the feasibility level of detail. Annual benefits reflect the January 1991 level of prices. The applicable interest rate for use in evaluating Federal water resources improvement projects for fiscal year 1991 is 8 3/4 %.

STUDY AREA

Chatham is located in Barnstable County, Southeastern Massachusetts, at the "elbow" of Cape Cod bordered by Pleasant Bay and Orleans on the north, the Atlantic Ocean on the east, Nantucket Sound on the south, and Harwich on the west. It is about 90 miles from Boston and 17 miles from Hyannis. The town has 66.8 miles of tidal shoreline providing opportunities to commercial fishing and recreation boating interests.

In 1980 Chatham had a year around population of 6,071. This represented an increase of approximately 33 % from 1970. Chatham is a summer resort community whose population nearly triples in the months of July and August. Its chief industry is that of servicing its many summer visitors. In 1983, the four leading industries reporting to the Massachusetts Division of Employment Security and their percentage of annual payroll were service, 29.2 %, retail, 25.6 %, government, 15.2 %, and construction, 10.0 %.

To the east of the main section of Chatham is a four mile sand dune strip of Nauset Beach peninsula extending southward, from the town of Orleans to the north, and forming a large bay. Prior to January 1987, the entire eastern shoreline of Chatham was protected by Nauset Beach, a barrier spit known locally as North Beach. During this time, fishing vessels that moored in Aunt Lydia's Cove and near Tern Island plus others who offloaded their catches at the Chatham Municipal Fish Pier would have to navigate Chatham Harbor in order to reach the Atlantic Ocean. Depths in the channel to Aunt Lydia's Cove were 5 to 7 feet MLW with a tidal range of 3 1/2 to 4 feet. On January 2, 1987, a northeast storm caused a breakthrough in Nauset Beach which has since

grown to a breach more than one mile in width. The impacts of this newly created breach in terms of navigation are as follows: (i) Vessels no longer have to navigate Chatham Harbor around the southern tip of Nauset Beach but can pass through the breach for access to the ocean. Navigating the breach though, is extremely dangerous due to swift currents, shifting shoals, and severe wave conditions. Using the breach is necessary because shoaling south of Chatham Harbor after the breakthrough has nearly precluded navigation between Nauset Beach and the mainland. (ii) The entrance channel to Aunt Lydia's Cove has shoaled to an average depth of one (1) foot at mean low water and the tidal range has increased by 0.6 feet to 4.6 feet.

WITHOUT PROJECT CONDITION

This section describes the factors that affect the supply and demand for fish in the absence of a Federal project. Fishery regulation and the status of stock are also included in the discussion as they impact on the economics of the fishery. Navigation related impacts on the Town of Chatham and the U.S. Coast Guard are also addressed along with recreation activities in Aunt Lydia's Cove.

Market Conditions

Chatham Fishing Fleet

Currently there are 246 vessels that fish out of Chatham. National Marine Fisheries report that in 1989 these vessels made 7,416 trips. For confidentiality reasons landings and value for Chatham are grouped with those from Provincetown and are shown in Table 1.

Fish landings and value are shown by species for Barnstable County of which Chatham and Provincetown are the major contributors in Table 2. In 1988 cod was the major species landed, comprising approximately 28 % of all landings.

Table 1
Landings and Value, Chatham and Provincetown
(Millions)

Year	Landings	Value
1986	26.6	$11.8
1987	25.3	$12.7
1988	25.2	$11.6
1989	23.7	$12.9

Table 2
Barnstable County
Catch and Value, 1988

SPECIES	POUNDS	VALUE (DOLLARS)
Alewives	22080	1840
Anglerfish	651300	387726
Bluefish	503194	111025
Bonito	300	183
Butterfish,Unc	7800	5312
Cod,At,Unc	9529900	5610264
Cunner	600	78
Cusk	60600	20992
Eels,Common	12225	13365
Flounder,At,Blackback,Unc (winter)	1775700	773917
Flounder,At,Dab,Sea,Unc (plaice)	159100	154987
Flounder,At,Fke,Unc	300000	422606
Flounder,At,Gray Sole,Unc	285700	485340
Flounder,At,Lemon Sole	6300	9386
Flounder,At,Sand (windowpane)	120500	47701
Flounder,At,Yellowtail,Unc	562300	697959
Flounder,At & Gf,Unc	17200	7666
Haddock,Lg	110800	173871
Haddock, Scrod	6200	6719
Haddock,Unc	1000	2084
Hake,At,Red	831500	90606
Hake,At,White,Unc	122300	42309
Halibut,At & Pa	3100	10189
Herring,At,Sea	60400	3833
Herring,Sea	120	12
Mackerel,At	470000	168157
Ocean Perch,At	4000	1688
Ocean Pout	918300	103727
Pollock,At	1247600	437695
Pollock,At & Pa,Unc	3000	960
Scups Or Porgies,Unc	576500	483073
Sea Basses,At,Black,Unc	255700	477231
Sea Trout,Gray,Unc	2900	2553
Shad,Unc	9060	1279
Sharks, Porgeagle	300	61
Sharks,Bonito(Shortfin Mako)	200	22
Sharks,Unc	7000	4741
Sharks,Dogfish,Spiny	2702100	137832
Skates	2813100	192210
Striped Bass,Unc	49324	84348
Sturgeons,Common green & white	3300	2517
Tautog	102100	47631
Tilefish	55300	138167
Tuna,Bluefin,Unc	490900	3644447
White Perch	32000	48112
Whiting,Unc	1963100	477673
Wolffish,At	164900	53078

BARNSTABLE COUNTY
CATCH AND VALUE
1988

SPECIES	POUNDS	VALUE (DOLLARS)
Finfishes,Unc For Food	49400	32631
Finfishes,Unc,Gen	3000	150
Finfishes,Unc,Bait,An. Food	3800	180
Crab,Unc	586900	277732
Lobster,American,Unc	1998604	6668272
Shrimp,At & Gf,Marine,Unc	119800	122997
Clams,Inshore,Hard,Public	343499	1730539
Clams,Hard,Private	25685	140100
Clams,Soft,Public	200929	1093110
Clams,Surf	1451300	785141
Snails(Conchs)	74000	78819
Mussels,Sea	757300	502150
Oyster,East. All Categories Cmbd	26436	324910
Scallop,Bay	24459	220790
Scallop,Sea	102400	432975
Squids,Unc	33200	11236
Squid,Short-finned	11000	678
Squid,Long Finned	2508300	980697
*** Total ***	34,340,915	$28,990,279

Stage Harbor and Aunt Lydia's Cove are the two centers of fishing activity in Chatham. Stage Harbor has a federally authorized channel of 10 feet mean low water (MLW) and is used primarily by trap fishermen who fish Nantucket Sound. Off-loading facilities for the trap fishermen are privately owned. However there is a public landing in Stage Harbor with adequate depth for the unloading of fishing boats. There is also a sizable recreation fleet in the harbor.

Aunt Lydia's Cove is the other major fishing center and the object of this study. The cove is located westward of the barrier beach and, until the breach, was protected by this spit. The Chatham Municipal Fish Pier is located in Aunt Lydia's Cove. The fish pier has facilities for off-loading and packing fish and is currently leased by the town to two fish buyers. The pier also has an additional area for off-loading known as the south jog. This area is used by fishermen selling to other buyers. The pier also supplies fuel and ice to the fishermen.

In 1990, 69 vessels had permits to off-load their cargos at the Municipal Fish Pier. The harvesting costs incurred by these fishermen will be affected by this project and will be analyzed in this study. Twenty-nine (29) of these boats are moored in Aunt Lydia's Cove and 39 boats are moored outside the cove in Chatham Harbor adjacent to Tern Island. One boat is moored to the north in Ryder's Cove. In 1990 these vessels landed 7,208,375 lbs. of groundfish (primarily cod) at the pier. This information was provided by the wharfinger. Landings of tuna, lobster and shellfish are not recorded by local officials. Landings by year and the number of boats with offloading permits is shown in Table 3.

Table 3
Landings and Fleet
Town Fish Pier,
Aunt Lydia's Cove
1962-1990

Year	Landings (lbs)	No.boats
1962	2,661,500	
1963	3,327,500	
1964	3,164,875	
1965	2,802,375	
1966	4,067,375	
1967	3,829,250	
1968	3,130,875	
1969	4,340,375	
1970	4,606,625	
1971	5,656,250	
1972	4,686,625	
1973	5,785,000	
1974	6,186,625	
1975	5,446,125	80
1976	4,108,500	91
1977	3,178,000	109
1978	5,562,500	123
1979	8,180,625	NA
1980	9,604,375	96
1981	8,500,625	74
1982	7,243,500	72
1983	5,877,250	65
1984	7,249,000	59
1985	7,304,000	53
1986	6,962,500	59
1987	8,280,750	78
1988	7,531,750	51
1989	8,186,625	75
1990	7,208,375	69

Note: The number of vessels permited to offload was not available for years prior to 1975.

Chatham fishermen use primarily static gear. Hooked lines or nets are set out and then collected usually 24 hours later. Groundfish are harvested in this manner with cod comprising approximately two-thirds of the catch. There are also some small draggers that operate out of Aunt Lydia's Cove. Tuna is caught primarily by rod and reel. A small number of lobstermen work out of the cove. Fishermen usually employ more than one type of gear. For example, cod may be caught in the spring and fall and tuna in the summer. Appoximately two-thirds of the boats fish year around. There is a seasonal component to fishing as landings nearly triple in the months of July and August when cod and tuna are plentiful. Approximately one-third of all groundfish landings occur in those two months. The number of boats that employ each gear type is shown in Table 4.

Table 4
Number of Vessels by Type of Gear
Aunt Lydia's Cove, 1990

Gear	No. Boats
Gillnet	22
Jig	35
Lobster Pots	17
Longline	35
Rod and Reel	29
Sein	4
Trawl	17

Fishing vessels in Aunt Lydia's Cove are all 50 feet or less in length. There is a length limit of 50 feet on the Chatham boats imposed by the length of the 2 offload stations at the Chatham Municipal Fish Pier. The typical boat in the fleet is a 45 footer and the fleet profile by length is shown in Table 5.

Table 5
Fleet Size Distribution
Aunt Lydia's Cove, 1990

Length	No. Boats	% of Fleet
20'-29'	5	7%
30'-35'	25	36%
36'-40'	15	22%
41'-50'	24	35%

Most of the fishing vessels in Aunt Lydia's Cove draw five feet or less unloaded. Fleet distribution by draft is given in Table 6.

Table 6
Fleet Draft Distribution
Aunt Lydia's Cove, 1990

Draft	No.Boats	% of Fleet
1.0'-2.0'	2	3%
2.1'-3.0'	11	16%
3.1'-4.0'	35	51%
4.1'-5.0'	6	9%
>5.0'	15	22%

The primary fishing grounds are from 20 to 100 miles off of Chatham on or near George's Bank in the Atlantic Ocean. The minimum travel time to the open ocean through the breach is 15 minutes one way. Prior to the breach the trip to the open ocean would take at least 45 minutes.

Fish Harvest Cost

Improvement projects under consideration in Chatham Harbor are not expected to affect the quantity of fish harvested. Thus, there should be no change in ex-vessel price of fish due to the project. The project will affect the depth related operating cost of fishermen using Aunt Lydia's Cove. The reduction of this cost in the with project condition is a project benefit.

Vessel characteristics were obtained from offloading permit applications and search and rescue information on file with the Coast Guard. This information was provided by the town wharfinger. Data elements obtained from this source were vessel name, length, beam, draft, location, crew size, engine size, hull construction, fuel type,residence status, and type of gear fished. From this information a record file was developed for each boat.

Activity information was provided by fishermen, fish buyers and the National Marine Fisheries Service (NMFS). Fishermen were queried as to their vessel length, draft, type of fishing, number of days fished, fuel utilization both underway and idle, number of times delayed and average delay, and damages incurred both from grounding and chaffing with other boats or the fish pier.

All fishermen were mailed a questionnaire by the wharfinger. Thirty-five percent were returned. Questionnaire response was used to develop fleet averages for trips, fuel utilization and damages. In order to clarify the data, the fishermen requested a second reformatted questionnaire of which approximately 61 percent were returned. This information was also supplemented with trip information from fish buyers and NMFS.

Tidal Delays

Tidal delays occur both in the spar channel and in the breach. Most of the delays occur in the spar channel, as fishermen are able to plan their trips through the breach at higher tide stages. In the without project condition, the most likely controlling depth of the breach is anticipated to be six feet MLW. Fishermen normally require 2.5 feet of underkeel clearance in the traversing the breach and 0.5 feet of underkeel clearance in the spar channel. Wave conditions in the breach require the additional safety factor particularly when easterly winds are prevalent.

For each boat, delay is estimated by multiplying the trips delayed by the average delay and the number of crewmen to determine total hours delayed per boat per year. Delay time is then aggregated over all boats in the fleet to determine total hours delayed for a given depth of the channel. As channel depth is varied so too are the number of delays.

Tidal delay was calculated by use of a mean tidal chart developed for Chatham and the depth required by each boat given its draft, underkeel clearance and channel depth. The number of trips delayed is estimated by multiplying the total number of trips times the percentage of the tidal cycle that delay is incurred given the depth that is needed. The extent of the delay is the average delay which is one-half the maximum delay for the depth needed. The Chatham mean tide chart is

Required Depth, ft	Maximum Waiting time, hrs
1	3.7
2	5.6
3	6.6
4	8.5

An example of this calculation would be as follows. If a vessel's draft and underkeel clearance exceed the channel depth by two feet, the percentage of trips delayed would be 5.6/12.4, or approximately 45 %. If a vessel makes 100 trips a year it is anticipated that 45 will result in possible tidal delay. The average delay is found by taking one-half of the maximum delay which is 0.5 X 5.6, or 2.8 hours. Some delays can be avoided by trip planning. The extent of avoidance of delays depends on the depth required for a vessel to transit the channel and the depth that is available in the channel. It is more difficult for a boat to avoid a delay when the spar channel is -1 foot MLW than if it is -3 feet MLW. Thus the percentage of delays avoided is variable depending on vessel draft and channel depth. If it is anticipated that approximately one-tenth these delays can be avoided through planning, this vessel would experience an estimated (45 X 0.9 X 2.8) 113 hours of delay a year. With a crew of two (reported crew size ranges from one to four), this would result in 226 labor hours delayed. This calculation is performed for each vessel in the fleet and aggregated to determine total labor hours delayed for the fleet. Labor hours are then valued at a proportion of their opportunity cost which is the average hourly wage for production workers in the Cape Cod labor market. The aggregated value of labor hours delayed is $69,300.

Hours delayed are valued at the prevailing hourly rate for production workers in manufacturing in the local labor market. This is done even though most fishermen receive a percentage or share of the revenue realized from the day's catch and not an hourly wage. The labor time lost during a delay represents an opportunity cost that the laboror would be otherwise productively occupied if it weren't for the delay. This productive time could involve such activities as vessel maintenance, net mending, equipment repair and preparation for the next trip. The Principles and Guidelines recognize this labor time foregone and offer guidance on its hourly value. "Value all labor, whether operator, hired or family at prevailing wage rates." The prevailing wage rate in the Massachusetts labor market area for similar labor was $11.75 per hour in June, 1991. The Massachusetts labor market area was used, as labor market data for Cape Cod is not published.

Although Chatham fishermen are remunerated on a share system it is felt that the share system will act as a wage system over time. Labor will need to be compensated for the extra time or will migrate to other uses. Some captains have already indicated that they are compensating fishermen for their additional time over and above labor's share of the revenue.

NED conducted a phone survey to learn how time saved by the project would be utilized by fishermen. Eleven fishermen were contacted and ten indicated that the time saved would be utilized in fishing activity such as preparing nets, baiting hooks, cleaning-up, and preparations for the next trip.

Reduction in delay would allow fishermen to get to these activities sooner. The additional time saved per week would not be used in providing labor services but instead result in an increase in leisure time. Fishermen were also queried as to the possibility of labor's share changing overtime to compensate for the hours delayed. None of the respondents indicated that labor's share would change. Thus, no evidence was found that the share system would act as a wage system, at least in the short term. Therefore tidal delay reduction results in an increase in leisure time which is valued at one-third the average hourly wage rate which would be $3.92.

Additional fuel cost due to delay is calculated in a similar manner. The average delay multiplied by the number of delayed trips determines an estimate of the hours of delay per boat per year. Fuel consumption per hour is used to determine the number of gallons of fuel consumed while the boat is delayed. Gallons of fuel consumed while delayed is aggregated over all boats and multiplied by the price per gallon charged at the Fish Pier. Currently this price is $0.92 per gallon. The aggregated value of additional fuel consumed is $14,200.

The two factors with the greatest impact on delay and damages would be the vessel draft and the number of trips expected to be taken annually over the project life of 50 years. Vessel size is not expected to change over time. Unloaded vessel drafts were obtained from the Wharfinger. Loaded drafts were estimated by adding one foot to unloaded drafts. Vessel trips were based on information provided by a dealer as it was felt to be more representative of the entire fleet than the information provided by the questionnaires for the 70 boat fleet. This number was then adjusted to account for fish landed at the south jog of the fish pier. The number of trips was increased by the ratio of the average number of trips for the years 1980 to 1989 to 1990 as activity in 1990 was down slightly. As the buyer did not deal in tuna and lobster, trips were increased by the number of tuna and lobster trips reported in the questionnaires. This process resulted in an average number of trips of approximately 85 per boat for 70 boats or 5,950 trips for the fleet. In the 49 questionnaires received fishermen reported a total of 5,457 trips in 1990. For 1989, National Marine Fisheries (NMFS) reported a total of 6,056 trips for all Chatham fishermen excluding trap fishermen that work out of Stage Harbor. In addition to delays on trips into the Fish Pier, fishermen that have their vessels moored in Aunt Lydia's Cove are experiencing delays entering the Cove after setting their gear. Thus trips by fishermen using static gear to the fishing grounds are included with the total number of trips. This results in an additional 1,785 (21 vessels X 85 trips) trips for a total of 7,735 trips for all fishermen.

Repair and Maintenance to Vessels

Even though the vessels usually wait for adequate underkeel clearance to navigate the Aunt Lydia's Cove spar channel and the breach, the constant and irregular shoaling still causes vessel scrapings on the channel bottom and occasional groundings.

At other times vessels can't wait for optimum underkeel clearance due to weather, offloading constraints, schedules, and traffic and must traverse the channel at the earliest opportunity. Scraping the bottom of the channel and occasionally grounding out results in increased repair and maintenance to vessels over and above normal annual repair and maintenance. In addition to grounding damages, fishermen are reporting damages to their boats due to ocean surge. Since the break in the barrier beach, Aunt Lydia's Cove boats are less protected from damages due to wave attack. The result has been damages to boats offloading and to the pier as well. Vessels are also susceptible to chaffing damages while at their moorings.

The vessel components which are affected are (i) hull - repairs due to scraping, (ii) propeller -rebuild tips worn down from churning in sand at high RPM, (iii) rudder and shaft - repair and rebalance, (iv) cutlass bearing - needs replacement every 2 years due to sand intrusion. (v) seawater pumps - need replacement every 2 years due to sand infiltration, (vi) pump impellers - need to replace 5-6 per year which become worn out due to passage of sand. The average annual additional maintenance and repair costs due to existing channel conditions for a 45 foot Chatham finfish vessel are enumerated in Table 7 below.

Table 7
Maintenance and Repair Costs
(45' Finfish Vessel)

Component	Annual Cost
Hull	$ 500
Propeller	600
Rudder and Shaft	500
Cutlass Bearing	400
Seawater Pumps	300
Impellers	200
Total Annual Cost	$2,500

Boats moored in Aunt Lydia's Cove due to congested conditions are more susceptible to chaffing damages at their moorings than those moored along Tern Island. However all boats are experiencing damages when trying to unload during unfavorable wind and wave conditions. Damage estimates were based on information provided by fishermen through surveys. Grounding damages in the without project condition are estimated to be $32,000. Damages were estimated per boat and aggregated over all boats for different channel depths. A boat fishing 150 days a year in the without project depth of 1 foot MLW would expect to receive the damages cited in Table 7. However, many boats fish less and damages per boat for the entire fleet is less. Grounding damages reported by 42 vessels in the survey was $60,305. Damages due to colliding with other vessels at their moorings and with the dock while offloading vary depending on the mooring location of the vessel. Boats moored in Aunt Lydia's Cove have a slightly higher damages as they have less room to swing at their moorings during periods of tidal surge. Collision damage reported in the surveys was $68,905. Depth related collision damage was estimated per boat and aggregated over all boats. This estimate is $21,300. In the without project condition, it is assumed

that 21 boats will leave Aunt Lydia's Cove. Not all damages reported by fishermen are related to the channel depth. For these two reasons, the estimated depth related damages are less than those reported in the questionnaires.

Loss of Value of Landings

Fish landed at the Chatham Municipal Fish Pier is marketed by the two buyers/wholesalers based on freshness. This is especially true of fish trucked to other parts of the Cape and New York. The last truck leaves the fish pier daily at 6 PM. If a vessel can't be unloaded in time to make the last truck then its catch becomes one day old, is no longer fresh and loses from 25 to 50 percent of its value. Thus, some of the delays result in reduced catch prices. The average catch for 69 boats is approximately 1100 lbs per trip. The average ex-vessel price for Chatham finfish is $1.00 per pound and the loss in value is estimated at 25 percent. A percentage of delays result in lost fish value. These delay losses are calculated for each boat using the average catch for all boats. The aggregated loss value over all boats is $39,300.

Transportation Cost

In the without project condition it is assumed that 21 boats that need a depth greater than the tidal range will leave Aunt Lydia's Cove for Stage Harbor or other ports. These are boats that would not be able to enter Aunt Lydia's Cove under any tidal stage in the without project condition.

Additional steaming cost is the additional fuel and labor required to travel an additional three and one-half hours roundtrip. The additional cost for fuel and labor is estimated per boat and aggregated over the entire fleet. This cost is estimated to be $93,100 for labor and $68,500 for fuel for a total of $161,600.

Market for Fish

Specializing in fresh fish, the wholesalers market the fish on Cape Cod, Boston, New York and as far away as Ohio and Florida.

Habitat Condition

The resource status is assessed annually by the National Marine Fisheries Service (NMFS) and reported in their publication, Status of the Fishery Resources Off the Northeastern United States. The information presented in this section is from this report and other reports prepared by NMFS.

The major species harvested in Chatham are groundfish. Groundfish stocks fell from 1963 to 1974, rose from 1975 to 1978, and have been declining ever since. The initial decline has been attributed to heavy foreign fishing, and the subsequent rise of restrictions to fishing effort imposed by the International Commission for the Northwest Atlantic Fisheries (ICNAF) and the Magnuson Fishery Conservation and Management Act (MFCMA). The major groundfish species harvested in Chatham are Atlantic Cod and Pollock.

Nominal catches of Atlantic cod and pollock for the years 1975 to 1989 in the area of Georges Bank and southward are presented in Table 8. Pollock landings also include the areas of Georges Bank and the Scotian Shelf. This area includes the Chatham fishing grounds.

Table 8
Nominal Catches of Atlantic Cod and Pollock
1975 - 1989
(thousand metric tons)

Year	Atlantic Cod	Pollock
1975	25.0	39.5
1976	19.9	38.3
1977	27.4	39.8
1978	35.5	47.1
1979	41.7	48.2
1980	51.4	56.5
1981	49.9	59.7
1982	64.0	54.1
1983	56.1	48.5
1984	42.4	51.3
1985	43.6	63.9
1986	27.8	68.7
1987	33.8	66.7
1988	45.3	58.1
1989	24.8	N.A.

The long term potential catch for Atlantic cod in the Georges Bank area southward is 35,000 metric tons. The long term potential catch for pollock in the Gulf of Maine, Georges Bank and Scotian Shelf is 54,000 metric tons. At current harvesting levels the projected spawning stocks for these two species are below maintenance levels. As a result Fishery Management Plan (FMP) targets for stock levels will not be achieved and the stocks are over exploited.

Fishery Regulation

Due to this exploitation of the Atlantic cod stock, the New England Fishery Management Council has set a goal of reducing the fishing mortality rate of cod by 10 % annually for the next 5 years. Current regulations include a minimum 5.5 inch diamond mesh and a minimum codfish length of 19 inches. Further restrictions on fishing effort might include increases in minimum mesh size, quotas, vessel tie-up days and closed areas. The impact of these proposed regulations on the Chatham fishing fleet cannot be determined at this time.

Other Facilities

Municipal

Since the breach the Municipal Fish Pier has been subjected to increased wear as boats damage the pilings when offloading during periods of wave surge. Wave surge is greatest during periods of high tide. It is anticipated that the town will expend $50,000 every 15 years for replacement of pilings and $11,000 for fenders every five years for replacement of fenders without the project over the next 50 years beginning in the anticipated first year of project life, 1993. This discounted cost is $4,200 as shown in Table 9.

Table 9
Piling and Fenders Replacement Without Project
Chatham Fish Pier

Replace. Year	Project Year	Cost	Present Worth (Lump Sum)	Capital Recovery Factor	Discount Annual Amount
1996	P(3)	11000	0.777521	0.088840	759
2001	P(8)	11000	0.511170	0.088840	499
2006	P(13)	61000	0.336062	0.088840	1821
2011	P(18)	11000	0.220939	0.088840	215
2016	P(23)	11000	0.145253	0.088840	141
2021	P(28)	61000	0.095494	0.088840	517
2026	P(33)	11000	0.062781	0.088840	61
2031	P(38)	11000	0.041275	0.088840	40
2036	P(43)	61000	0.027135	0.088840	147
2041	P(48)	11000	0.017840	0.088840	17
				Total Cost	$4222
					$ 4200

To assist fishermen in keeping Aunt Lydia's Cove open the town is currently dredging the channel. In the fall of 1989 the channel was dredged to a depth of -7 MLW. The current controlling depth is currently -1 MLW. The spar channel was again dredged to -8 MLW in 1991. However, correspondence from Town officials indicated that future dredging is not likely. The initial appropriation was raised as a stop gap measure until a long term solution could be found. Chatham voters have recently been hesitant to raise taxes to cover increased Town spending.

Coast Guard

The increased repair and maintenance costs to the Coast Guard vessel are similar to those of the fishing vessel except that the 44' Lifeboat has two engines and a hollow keel. Coast Guard cost induced by shoaling is shown in Table 10.

Table 10
Maintenance and Repair Cost
Coast Guard , Aunt Lydia's Cove
(44' Motor Lifeboat)

Component	Annual Cost
Hull	$1,000
Propellers (2)	1,000
Rudders and Shafts (2)	1,000
Cutlass Bearings (2)	800
Seawater Pumps	1,000
Impellers	100
Total Annual Cost	$4,900

After the breakthrough occurred in Nauset Beach and the Aunt Lydia's Cove spar channel shoaled to an average depth of 3' MLW, the 44' Coast Guard Motor Lifeboat could not navigate the channel for 4 hours out of each 12.4 hour tidal cycle due to inadequate depth. In order to fulfill their rescue capability on a 24 hour basis the Coast Guard was compelled to purchase a 28' rigid hull, jet powered inflatable craft in 1988. This boat draws only 6 inches of water and therefore enables rapid response on a 24 hour basis. With an initial cost of $148,000, the inflatable boat must be replaced every 10 years, without the project. With the project, the 44' Motor Lifeboat could handle all missions at all stages of the tide and the inflatable boat would not be needed. The replacement cost of the inflatable expended every ten years over the 50 year evaluation period beginning in 1992, discounted to present worth and amortized is $15,000 annually. Annual maintenance on this craft is estimated to be $1,500. The discounting of replacement cost for the inflatable craft is shown below in Table 11.

Table 11
Annualization of Inflatable Vessel Replacement Cost

Replacement Year	Project Year	Replacement Cost	Present Worth LS	CRF (50 yrs)	Annual Cost Avoided
1998	P(5)	$148,000	.657436	.088840	$ 8,644
2008	P(15)	"	.284158	"	3,736
2018	P(25)	"	.122819	"	1,615
2028	P(35)	"	.053085	"	698
2039	P(45)	"	.022944	"	302
			Total Cost =		$14,995
					$15,000

In summary shoaling of the spar channel (as well as the breach) has increased the harvesting cost of the commercial fishing fleet and the operating cost of the Town of Chatham and that of the United States Coast Guard. The costs shown in Table 12 refer only to delays and damages in the spar channel given that the controlling depth of the breach is six feet MLW.

Table 12
Without Project Depth Related Harvesting Cost
(Spar Channel at 1 foot MLW)

Commercial Fishing	
Delay	
Labor	$ 69,300
Fuel	14,200
Fish Value	39,300
Total Delay	$122,800
Damages	
Grounding	32,000
Collision	11,200
Total Damages	43,200
Transportation	
Labor	93,100
Fuel	68,500
Total Transportation	$161,600
Total Commercial Fishing	$327,600
US Coast Guard	
Damages	4,900
Avoided Cost	16,500
Total Coast Guard	$ 21,400
Town of Chatham	
Damages	$ 1,500
Grand Total	$350,500

Shoaling of Aunt Lydia's Cove has increased the harvesting cost of local fishermen. It also has increased the level of danger in an already dangerous occupation. It is expected that in the without project condition the spar channel will shoal to a depth of 1 foot MLW. This depth precludes some vessels from entering the cove even at high tide as the the tidal range is only 4.6 feet. Fishermen have resorted to the use of skiffs to offload their vessels outside the channel. These heavily ladened skiffs are susceptible to sinking especially during periods of tidal surge. Recently one fisherman was knocked into the water while unloading his skiff at the pier. Fortunately, others were nearby to effect his rescue. Although safety is difficult to quantitify, current harvesting conditions are unsafe and an improvement project would lessen this danger. As it is anticipated that the larger boats will relocate in the without project condition, the amount of skiffing, with its inherent dangers, will decline.

Recreation

Recreational use of Aunt Lydia's Cove primarily consists of 10 boats that are moored in the Cove, two party boats and eight sport fishing boats. This information was provided by the Wharfinger. There are a number of other recreational boats that utilize the Cove to obtain gasoline for their boats. However, information on the extent of this use was not available.

WITH PROJECT CONDITION

Improvement Plans

There are five plans of improvement under consideration in Chatham. These plans address the two major navigation problems at Aunt Lydia's Cove: insufficient depth in the spar channel causing delays and vessel damages, and exposure to wave action resulting in damages to fishing vessels and the municipal pier. Briefly, these plans are

1) Plan A - transferring the fleet to nearby Stage Harbor
2) Plan B - deepening the existing entrance channel and anchorage area to Aunt Lydia's Cove.
3) Plan C - relocate the entrance channel north of Tern Island
4) Plan D - structure to protect Aunt Lydia's Cove from wave action
5) Plan E - combines the channel and anchorage of Plan B with a jetty.

Market Conditions

The project is not anticipated to have an effect on the fish catch. Its purpose is to increase the net income of fishermen by lowering their harvesting cost by reducing delays and damages and for those fishermen that have relocated to other ports, by reducing travel time to their fishing grounds.

In the without project condition the average controlling depth in the spar channel is assumed to be one foot (MLW). In the without project condition, the most probable condition is that the Town will not be able to dredge the channel annually. In October, 1989 the town dredged the channel to -7 feet MLW. As of December 1990, the channel depth was a little less than -1 foot MLW. Thus in little more than a year's time the channel had shoalled in by 6 feet. In the spring of 1991 the spar channel was again dredged to -7 feet MLW. Minus one foot is taken as the average controlling depth of the spar channel based on the current shoaling rate.

Other Facilities

Municipal

Plan D will reduce annual maintenance cost of the Municipal Fish Pier to $1,300. The derivation of this cost is shown in Table 13.

Table 13
Pilings and Fenders Replacement With the Project

Replacement Year	Project Year	Cost	Present Worth (Lump Sum)	Capital Recovery Factor	Present Worth
2001	P(8)	11000	0.511170	0.088840	499.00
2011	P(18)	11000	0.220939	0.088840	215.00
2021	P(28)	61000	0.095494	0.088840	517.00
2031	P(38)	11000	0.041275	0.088840	40.00
2041	P(48)	11000	0.017840	0.088840	17.00
				Total Cost	$1290.00
					$1300

Coast Guard

All plans but D will eliminate the need for a deflatable vessel saving the Coast Guard $16,500, annually for purchase and maintenance over the life of the project. Increased maintenace cost on the MLB will also be eliminated saving $4,900 annually.

Channel deepening will increase the operational efficiency of the Coast Guard allowing them to respond to emergency situations in a more timely fashion.

NED BENEFIT

Project benefit is determined by taking the difference in fish harvesting cost (delays, damages and travel time), municipal dredging and pier maintenance cost, Coast Guard vessel maintenance cost and recreation value between the with and without project conditions.

Plan A - Relocate fleet to Stage Harbor

Although this plan would alleviate the delays and damages associated with Aunt Lydia's Cove, it would significantly increase travel time to the fishing grounds. Currently, Stage Harbor does not have enough anchorage area for the fleet. The cost of this alternative would include dredging for additional anchorage area and the extra travel time needed to reach the fishing grounds in the Atlantic Ocean. Additionally, dock facilities including parking would need to expanded. Although this cost would be borne by the locals it is included in total project cost.

Currently the one way trip through the breach to the fishing grounds takes a minimum of 15 minutes. Before the breach fishing vessels from Aunt Lydia's Cove would need to travel around Nauset Beach before heading north to their fishing grounds. This trip would take a minimum of 45 minutes. It would take these vessels 2 hours one-way to reach their fishing grounds from Stage Harbor. The vessels would enter Nantucket Sound and then sail south clearing Monomoy Island before heading north to their fishing grounds. It is estimated to take approximately one hour at 8-10 knots to clear Monomoy Island and another hour to reach the fishing grounds. This additional cost is estimated to be $444,900 annually. As this exceeds $166,000 which is the cost of delays and damages incurred without the project by Aunt Lydia's Cove fleet, this alternative is not economically feasible as the net benefit would be negative and the benefit-cost ratio would be less than one. This cost was obtained by calculating the additional Labor and fuel resources needed to travel the additional distance to the fishing grounds. This cost was estimated per boat and aggregated over all boats in the fleet.

Plan B - Deepen Present Channel

Plan B at all depths under consideration will eliminate Coast Guard damages and avoid replacement cost for an inflatable vessel. It estimated that Plan B at a depth of four feet would reduce damages to the town pier by approximately 50 %. Coast Guard and town damages and costs without the project can be found in Table 12.

There are four variations to Plan B. Plan B1 provides for a two foot differential between the depth in the spar channel and the depth in the breach. Plan B2 does not provide for dredging in the breach. Plans B3 and B4 are the same as B1 and B2, respectively, only they allow for the possibility of project failure due to insufficient maintenance.

Table 14
Depth Related Fleet Delays and Damages, Aunt Lydia's Cove

DEPTH	LABOR DELAY	FUEL DELAY	LOST FISH VALUE	STOT	GROUNDING DAMAGE	COLLISION DAMAGE	STOTAL	TRIP FUEL	TRIP LABOR	STOTAL	TOTAL
1	$69,300	#14,200	$39,300	$122,800	$32,000	$11,000	$166,000	$68,500	$93,100	$161,700	$327,700
2	31,400	6,200	27,600	65,200	28,500	10,000	103,600	44,000	61,100	105,000	208,700
3	11,900	2,200	18,000	32,800	28,800	10,100	71,700	12,600	18,600	31,200	102,900
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0

Plan B1 benefit for deepening the present spar channel and the breach is shown in Table 15. Benefit for depths of 4, 6 and 8 feet in the spar channel are determined by subtracting the delays and damages associated with these depths respectively from the without project delays and damages occurring at a depth of one foot in the spar channel and 6 feet in the breach. The corresponding depths provided in the breach would be 6 feet, 8 feet and 10 feet, respectively. As the breach depth is 6 feet naturally, it is not anticipated that any dredging in the breach will be necessary for the 4 foot spar channel.

Due to the high shoaling rates, the effective controlling depth will be less than the authorized project depths. For a four foot project average controlling depth will be three feet. For six and eight feet projects, the average controlling depth will be 5 and 7 feet respectively. For plan B annual maintenance is scheduled for three times a year with a shoaling rate of one-half foot per month.

Table 15
Plan B1 Benefit

Project Benefit	Project Depth 4'	6'	8'
Delay			
labor saving	$57,400	$143,700	$146,800
fuel saving	12,000	28,800	29,300
catch value	20,500	45,400	50,800
Total Delay	$89,900	$217,900	$226,900
Damages			
grounding	3,200	32,000	32,000
collision	1,100	11,200	11,200
Total Damages	4,300	43,200	43,200
Transportation			
labor saving	74,500	93,100	93,100
fuel saving	55,900	68,500	68,500
Total Transportation	$130,400	$161,600	$161,600
Total Commercial	$224,600	$422,700	$431,700
Coast Guard			
damages	4,900	4,900	4,900
avoided cost	16,500	16,500	16,500
Total Coast Guard	$ 21,400	$ 21,400	$ 21,400
Town			
damages	1,500	1,500	1,500
avoided cost	0	0	0
Total Town	1,500	1,500	1,500
Recreation	2,500	2,500	2,500
TOTAL	$250,000	448,100	$457,100

Reduced damages and delays require that an additional two feet of depth be in available in the breach. For the 4 foot option no additional dredging will be needed as the breach has been found by survey, to have at least 6 feet of navigable water. However, a 6 foot spar channel would require an 8 foot breach channel and an 8 foot spar channel would require a 10 foot breach channel.

Plan B1 will result in a local cost saving of $1,500 on the replacement of fenders and pilings at the pier. The Coast Guard will save $4,900 in annual maintenance on the MLB and $16,500 avoided cost for an inflatable boat and its maintenance. The town and Coast Guard cost savings is added to the commercial fleet cost saving to obtain total Plan B1 benefit.

Plan B2 is similar to Plan B1 with the exception that there is no dredging in the breach. Thus an additional two feet of depth is not provided in the breach for a project depths of 6 feet and 8 feet in the spar channel. The controlling depth of the breach is taken as six feet. Fisherman under normal operating conditions do not pass through the breach unless they have 2.5 feet of underkeel clearance. Project benefit is shown in Table 16.

Table 16

Plan B2 Benefit

Project Benefit	Project Depth 4'	6'	8'
Delay			
labor saving	$57,400	$69,300	$69,300
fuel saving	12,000	14,200	14,200
catch value	20,500	39,300	39,300
Total Delay	89,900	122,800	122,800
Damages			
grounding	3,200	32,000	32,000
collision	1,100	11,200	11,200
Total Damages	4,300	43,200	43,200
Transportation			
labor saving	74,500	93,100	93,100
fuel saving	55,900	68,500	68,500
Total Transportation	130,400	161,600	161,600
Total Commercial	224,600	327,600	327,600
Coast Guard Damages	4,900	4,900	4,900
avoided cost	16,500	16,500	16,500
Total Coast Guard	21,400	21,400	21,400
Town			
damages	1,500	1,500	1,500
Total Town	1,500	1,500	1,500
Recreation	2,500	2,500	2,500
TOTAL	$250,000	$353,000	$353,000

Benefits developed for Plans B1 and B2 assume that maintenance dredging can be performed several times annually. If not, the project is in danger of failing or not performing to the level needed to generate the stated benefits. Projects are typically evaluated assuming that they will receive the required maintenance and perform adequately. A navigation project once completed will have to compete with existing projects for a limited amount of maintenance dredging funds. Given the frequency and quantities of dredged material involved, as well as environmental restrictions and the uncertainty of long term disposal options, it is unlikely that the Corps would be able to provide the necessary maintenance. Thus it is more realistic to assume that maintenance dredging will occur every three years instead of yearly. Plans B3 and B4 are the same as Plans B1 and B2, respectively, with the exception that benefits and costs accrue on a 3 year cycle. However, given that the channel at its most critical point will shoal in approximately 6 feet per year, the spar channel will have an average controlling depth of 1 foot after a year for all but the 8 foot project. As the without project depth is attained, project benefit is minor and is not shown for plans B3 and B4.

Plan C - Provide New Entrance Channel

This improvement plan would involve a new entrance channel to Aunt Lydia's Cove north of Tern Island allowing the current channel to shoal-in. Plan C has four variations similar to Plan B. Plan C1 includes providing a two foot differential between the depths of the breach and that of the new entrance channel to Aunt Lydia's Cove. Plan C2 would not provide for dredging in the breach. Plans C1 and and C2 benefits will be identical to Plan B1 and B2 benefits, respectively. However, net benefit for Plans C1 and C2 will differ from Plans B1 and B2 as respective plan costs will be different. These benefits are shown in Tables 17 and 18. Plans C3 and C4 are the same as Plans C1 and C2, respectively, except that maintenance is performed every three years and not annually.

The new entrance channel north of Tern Island that is part of Plan C will increase travel distance to the fishing grounds by approximately 1.3 miles. At a speed of 10 miles per hour in the channel, travel time will increase by 0.26 hours for a roundtrip. It is estimated that labor cost will increase by $18,900 annually and fuel cost will increase by $14,200 for a total increase of $33,100 for the fishing fleet.

In Plan C, although the project depths under consideration are four, six and eight feet; the effective depths, as in Plan B, are expected to be three, five and seven, respectively. For Plan C maintenance would be one and a half times a year instead of three times a year for Plan B as shoaling rates are less.

Table 17
Plan C1 Benefit

	Project Depth		
	4'	6'	8'
Commercial	$224,600	$422,700	$431,700
Coast Guard	21,400	21,400	21,400
Town	1,500	1,500	1,500
Recreation	2,500	2,500	2,500
Total Benefit	$250,000	$448,100	$457,100

Table 18

Plan C2 Benefit

	Project Depth		
	4'	6'	8'
Commercial	$224,600	$327,600	$327,600
Coast Guard	21,400	21,400	21,400
Town	1,500	1,500	1,500
Recreation	2,500	2,500	2,500
Total Benefit	$250,000	$353,000	$353,000

Plans C3 and C4 are the same as C1 and C2 only maintenance is provided every three years. Shoaling rates in a channel north of Tern Island would average approximately three feet a year as compared with approximately six feet per year in the current channel south of Tern Island. Whereas providing maintenance on a three year interval would cause Plan B to fail, Plan C would continue to operate but in a degraded state. Benefits were reduced to reflect shoaling in the channel. For a six foot project, the spar channel depth would be 3.0 feet at the end of year one, 1.0 foot at the end of years 2 and 3. At the end of year 3, maintenance would be provided and the cycle would be repeated over the project life. Channel depth is not expected to go below one foot.

Yearly benefit is discounted and annualized at the project discount rate to determine average annual benefit. Plan C3 project benefit was developed, but is not shown here.

Plan C3 and Plan C4 at a depth of 4 feet in the spar channel would result in an average controlling depth of 2.5 feet during the first year after dredging and a controlling depth of 1.0 feet during the second and third year.

Plan C4 is similar to Plan C2 in that there would be no dredging in the breach. The plans differ as in Plan C4 maintenance would be performed every three years instead of yearly as in Plan C2. Plan C4 benefit is shown in Table 19.

Table 19

Plan C4 Benefit

	Project Depth		
	4'	6'	8'
Commercial	$55,400	$179,700	$226,900
Coast Guard	21,400	21,400	21,400
Town	1,500	1,500	1,500
Recreation	2,500	2,500	2,500
Total Benefit	$80,800	$205,100	$252,300

Plan D - Protection from Wave Action

This plan would provide a structure to prevent wave attack on boats offloading at the pier and in their moorings. Since the breach, wave surge has caused boats to hit the pier causing damage to both boat and pier. Boats are also chaffing together at their moorings. Plan D will reduce these wave related damages. Benefit derivation assumes that the a Federal channel is not provided. Channel deepening will reduce damages to the pier and vessels as fewer vessels will be offloading during high tides when surge conditions are worse. Project benefit is shown in Table 20.

Table 20
Plan D Benefit

Reduced Damages to Vessels	$21,300
Reduced Damages to Pier	2,900
Total Annual Benefit	$24,200

Plan E - Channel with Jetty Structure

Plan E benefit will be a combination of Plan B and Plan D benefits. The jetty will not only provide protection against wave attack but will also affect shoaling rates thereby lowering maintenance cost. Only two variations will be considered. Benefit for Plan E2 is presented in Table 21.

Plan E is only evaluated at a depth of six feet. The benefit for Plan E is the same as Plan B with the exception of collision damages to boats and damages to the pier resulting from these collisions. Plan D benefit replaces Plan B benefit for these categories in Plan E.

Plans E1 and E3 involve deepening in the breach along with the inclusion of a jetty. Plan E1 requires annual maintenance and in Plan E3 maintenance would be provided every three years. In analysis of Plans B and C, alternatives that provided for dredging of the breach had lower net benefits than their counterparts that did not. For this reason, detailed benefit and cost estimates were not developed for Plans E1 and E3.

Plan E2 combines the benefit of Plan B2 with that of Plan D. Plan E2 benefit is given in Table 21.

Table 21
Plan E2 Benefit

Project Benefit	Project Depth 6'
Delay	
Labor Saving	$69,300
Fuel Saving	14,200
Catch value	39,300
Total Delay Damages	122,800
Grounding	32,000
Collision	21,300
Total Damages	53,300
Transportation	
labor saving	68,500
fuel saving	93,100
Total Transportation	$161,600
Total Commercial	$337,700
Coast Guard Damages	4,900
avoided cost	16,500
Total Coast Guard	21,400
Town	
Damages	2,900
avoided cost	-0-
Total Town	2,900
Recreation	2,500
TOTAL	$364,500

Plan E4 is similar to Plan E2 in that maintenance would be provided every three years. The jetty would reduce the average shoaling rate to three feet a year for the controlling depth. Thus the project would degrade as with Plan C4 and would not fail as in Plan B4. Project benefit is presented in Table 22.

Table 22
Plan E4 Benefit

	Project Depth 6'
Damage Benefit (Collision)	$ 21,300
Other Comm. Benefit	175,200
Commercial	196,500
Coast Guard	21,400
Town	2,900
Recreation	2,500
Total Benefit	$223,300

Recreation

Plans B, C and E at all depths will increase recreation value in Aunt Lydia's Cove. Recreation value is estimated for both the with and without project conditions using the unit day value methodology described in ER 1105-2-100, Chapter Six, Section VIII, NED Benefit Evaluation Procedures: Recreation.

This methodology consists of taking the product of user days and unit day value for the with and without project condition. The difference in recreation value is a project benefit. This information is shown in Table 23. The number of user days was determined with information provided by the Wharfinger. The determination of recreation rating for Aunt Lydia's Cove is shown in Table 24.

Table 23
Recreation Benefit
Aunt Lydia's Cove

NO. OF USER DAYS	WITHOUT PROJECT	WITH PROJECT
Party Fishing	2772	2772
Sport Fishing	840	840
Moorings	975	975
Total	4587	4587
UNIT DAY VALUE	$3.29	$3.84
RECREATION VALUE	WITHOUT PROJECT	WITH PROJECT
	$15,100	$17,600
BENEFIT	$ 2,500	

Table 24
Recreation Rating
Aunt Lydia's Cove

	Without Project	With Project
1. Recreation Experience	5	5
2. Availability of Opportunity	3	3
3. Carrying Capacity	7	7
4. Accessibility	1	12
5. Environmental Quality	13	13
TOTAL	29	40
USER DAY VALUE	$3.29	$3.84

APPENDIX 2

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

Aunt Lydia's Cove
Appendix 2
Engineering Investigations, Design & Cost Estimates

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Description of Project Area

The town of Chatham is located on Cape Cod in eastern Massachusetts and is bounded by water on three sides: to the north by Pleasant Bay, to the east by the Atlantic Ocean, and to the south by Nantucket Sound. A 10-mile long barrier beach, called Nauset Beach, used to separate Chatham Harbor and Pleasant Bay from the Atlantic Ocean. In January 1987 Nauset Beach was breached during a northeast storm. Since then, the southern access through Chatham Harbor has virtually closed off and most boats access the open ocean through the breach that has now widened to over a mile.

The small port of Aunt Lydia's Cove is located in Chatham Harbor. Aunt Lydia's Cove is a busy commercial fishing base for approximately 69 fishing vessels. Several recreational vessels also use the cove for taking on supplies. The Chatham Municipal Fish Pier located in Aunt Lydia's Cove was originally constructed in the 1940's and is the center of operations for the commercial fleet. The pier provides ice, fuel and an area for fishermen to conduct light repairs on their equipment. The U.S. Coast Guard also operates a rescue station at the cove.

Though the breach allows the fishing vessels shorter access to the fishing grounds, it is also the cause of some very serious problems in the area. Without the continuous protective beach large quantities of drifting sand are allowed to pass into Chatham Harbor. Large shifting shoals make navigating difficult at the cove and the breach. The direct exposure to the open Atlantic has also increased the amount of swell in Chatham Harbor; causing increased erosion of the shoreline and damage to the commercial fleet and pier at the cove. The problems at Aunt Lydia's Cove resulted in this feasibility study to determine if there were any navigation improvement plans in which the Federal government could participate.

Previous Studies

This engineering analysis included a review of previous reports, conducted by the Corps of Engineers, on the Chatham Harbor area. Several studies have been completed and the information yielded by this work was seen as pertinent to understanding and designing a Corps project.

The survey reports for Stage Harbor were evaluated but were found to be silent regarding information on Nauset Beach and the Chatham Harbor area.

The first report examined was the Pleasant Bay Survey Report of 1968. This study was conducted as a result of increasingly poor navigation conditions in Pleasant Bay and Chatham Harbor. This report showed that a previous break in Nauset Beach occurred in 1846 opposite Allen Point. The detached southern portion, South Beach, gradually welded to the mainland. The remaining part of Nauset Beach, North Beach, then began the process of growing south. By 1960 the tip of Nauset extended just south of Morris Island. Vessels leaving Chatham Harbor entered the Atlantic Ocean between Nauset Beach and Monomoy Island.

Shifting sandbars at the inlet as well as meandering channels in Chatham Harbor and Pleasant Bay made navigation difficult if not impossible during

the lower tide stages. Problems at the inlet were not so much a function of depth but of wave activity in the area. The inlet was directly exposed to the Atlantic Ocean and was therefore often subject to very rough wave conditions. At this inlet fishermen experienced groundings and delays due to the shifting shoals and waves. Depths were often around 4 to 5 feet at Mean Low Water (MLW). Breaking waves often kept fishermen from leaving on relatively good days. From 1945 to 1967 eleven lives were lost and four vessels sunk in the inlet. The natural channels of Chatham Harbor were also subject to shifting shoals causing delays and damages. The shoal material further up the bay was a result of Nauset Beach being eroded by wind and wave over-topping. During the 25 years prior to the study it was determined that about 1,000,000 cubic yards of material was deposited in Pleasant Bay and Chatham Harbor.

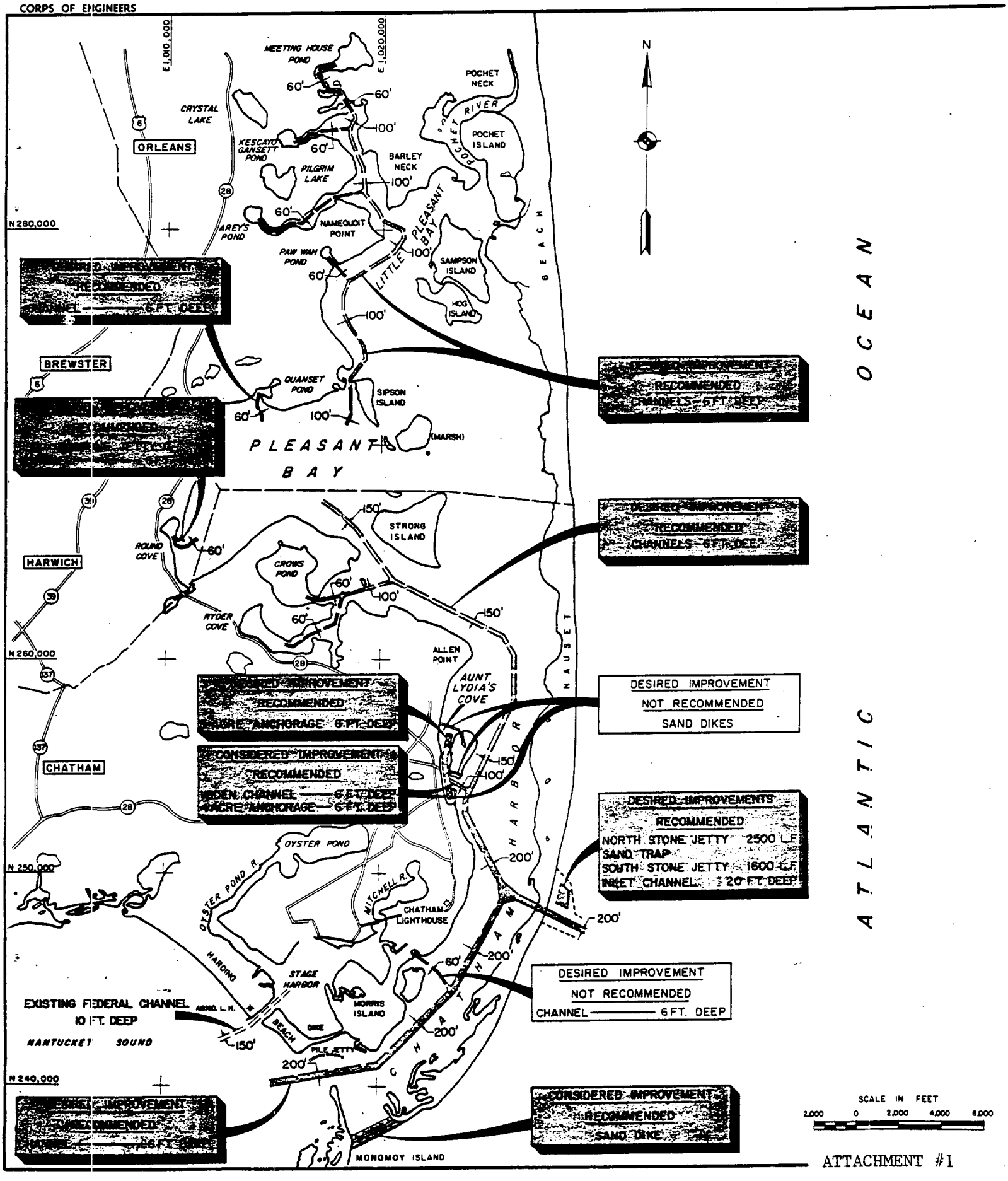
The Corps of Engineers' study recommended an elaborate system of channels, dikes, jetties, a sand bypass system, and dune restoration on Nauset Beach (see Attachment 1). The study based its recommendation on the fact that channels in the bay were dependent on the provision of a dependable access to the ocean and on the integrity of Nauset Beach. Due to the large amount of littoral drift along Nauset Beach (gross 900,000 cy/yr) a permanent, stabilized inlet was necessary (20 feet deep at MLW and 1000 feet wide). Each element of the plan was essential to the navigation project's success. Though authorized, the project was never built as local construction funds could not be secured.

A reconnaissance report for the Pleasant Bay area was conducted in 1978 by the Corps of Engineers. Conditions for commercial and recreational boats continued to be treachorous and local authorities requested the Corps to examine scaled down, less expensive alternatives to improve navigation. Six alternatives including: an untrained, man-made inlet through Nauset; an inlet and dike between Morris and Monomoy islands; an inlet, a dike between Nauset and Monomoy, and a cross-over channel between Monomoy and Morris islands; a no action plan; a dike as in the second plan along with dune restorations; and relocation of the fleet to Nauset Harbor, were studied (see Attachment 2).

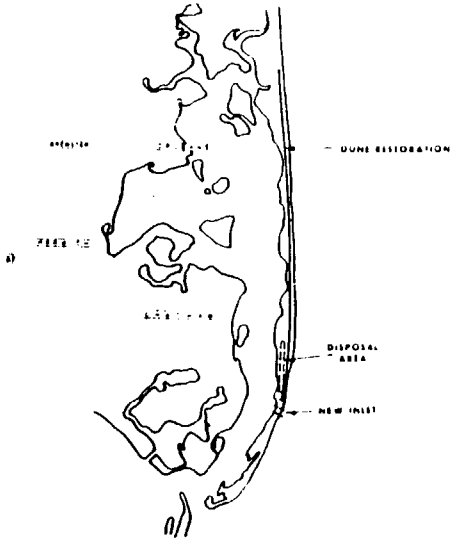
The report stated that there were "serious questions concerning the economic justification for providing less than authorized navigation improvements". Any un-stabilized inlet was not guaranteed to stay open. If a natural inlet were to occur at a different location the tidal prism would have two inlets and navigation depths would be further jeopardized. Relocation of the fleet to the even more unstable Nauset Harbor was out of the question. The study concluded that the less expensive alternatives to improve navigation were not economically justified and therefore not in the Federal interest.

As a side note, several private consultants were asked to comment on the various alternatives examined. All agreed that partial solutions to a very complex problem could do more harm than good. The best option was to let the system h[illegible]. Channels would continue to shoal and change location and this would require frequent and careful placement of channel markers. However, the Nauset Beach area was too dynamic a system to be tinkered with.

In 1989 the Corps of Engineers completed a Congressionally authorized



ATTACHMENT #1



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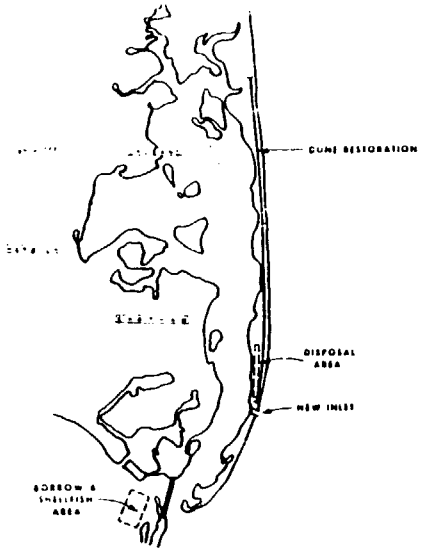

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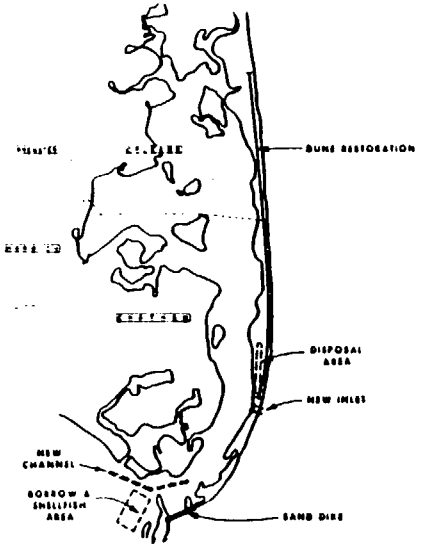

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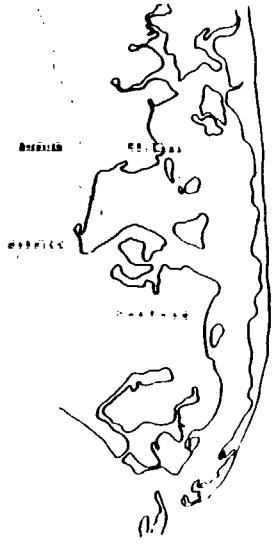

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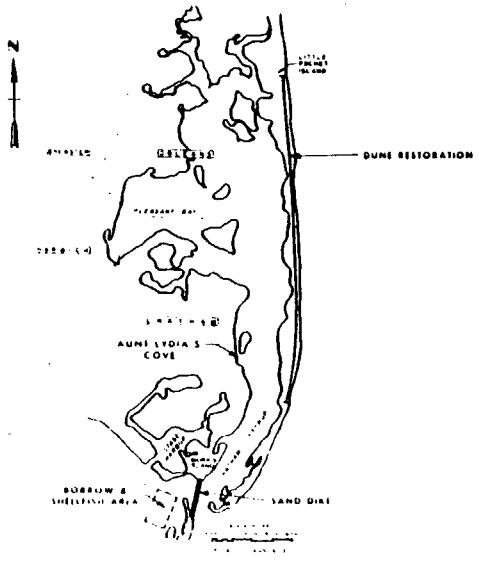
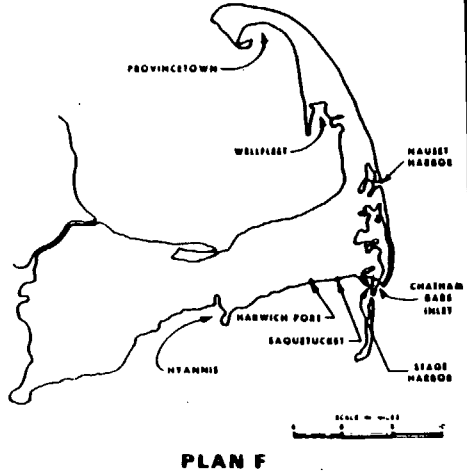


PLAN E
SELECTED PLAN



PLAN F

CORPS OF ENGINEERS · NEW ENGLAND DIVISION

CHATHAM BARS INLET

ALTERNATIVE PLANS

SEPTEMBER, 1979

ATTACHMENT #2

General Investigation Reconnaissance Study. This reconnaissance study was undertaken as a result of the breaching of Nauset Beach in January 1987. The new inlet quickly widened causing an increase in the tide range, exposure to the wave forces of the Atlantic Ocean, and severe sediment deposition from Nauset Beach. Extensive shoreline erosion and shoaling in Chatham Harbor and Pleasant Bay and an increase in water quality have resulted. The final report did recommend that an additional navigation improvement study be undertaken and provides the most recent information available on the area.

As shown on Attachment 3, Nauset Beach was last breached in 1846 opposite Allen Point. The study revealed that net littoral drift on the lower portion of Nauset Beach, occurs in a southerly direction. Gross potential transport for the years 1956 to 1975 was found to be 900,000 cy/yr. The exact amounts and their directions, moving along the beach, are difficult to pinpoint as a result of the changing bathymetry in the area. The breach, as evidenced in previous cycles, interupts the movement of sand to the beach, south of the break, causing South Beach to starve. This starvation caused South Beach to erode and eventually break-up during the last cycle. In 1871 a second breach occurred opposite Chatham Lighthouse. Within 50 years of the initial breach, the southern portion of Nauset Beach had begun the process of eroding, retreating to the west, and eventually welding to the mainland. It was then that Nauset Beach began regenerating, growing to the south, and again forming a protected Chatham Harbor by the 1950's. Growth and restriction of tidal exchange eventually resulted in the breach of 1987.

Mathematical modeling of the system determined that the new inlet would grow slightly larger and the old inlet would experience severe shoaling to reach their equilibrium points. This has in fact been the experience over the last few years as the portion of Chatham Harbor behind South Beach has shoaled considerably and New Inlet has actually slowed its widening process. While it appears some equilibrium is being reached, the effects of sediment transport, wind, wave, and tidal action will never allow the inlet to stabilize completely.

The General Investigation report found that prediction of the future state of navigation conditions in Chatham Harbor was very difficult to determine. The process historically has been that South Beach erodes, breaks-up, and welds to the mainland. The U.S. Army Corps of Engineers' Coastal Engineering and Research Center (CERC) stated that the "evolution and migration of the breach system and the migration of South Beach has tremendous potential impacts on navigation".

In conclusion, the Nauset Beach system has a documented cycle (roughly every 130 years) of breach, degeneration, and growth. Research of the study area's history shows that navigation conditions, in the harbor and at the old inlet, have been far from ideal. Since the early 1940's when the Municipal Fish Pier was first built, boaters have experienced groundings, delays, sinkings, and fatalities as a result of the shifting shoals and breaking waves at the inlet. Many of these problems are attributable to the fact that the dominant drainage path for Chatham Harbor existing during the 1950's, 60's and 70's was southwest through the Morris/Monomoy Island cut. This resulted in the fishermen of Aunt Lydia's Cove never having guaranteed safe access through the everchanging inlet.

The new inlet formed by the break has and continues to be a source of great shoaling for Chatham Harbor. A summary of the hypothetical shoaling patterns currently experienced can be seen in Attachment 4. Shoal material from the flood delta southeast of Aunt Lydia's Cove is a great contributor to the fishing fleet's problems. However, it has also been observed that the situation is intensified by wave attack on the Chatham shoreline. Eroded material is brought north along the shore and fills in the areas around Tern Island.

The South Beach spit has grown substantially so that it is almost completely attached to the mainland at low tide. Much of the bar is several feet above the low water line; cutting off navigation for all but the smallest draft vessels who wish to access the old Chatham Harbor inlet.

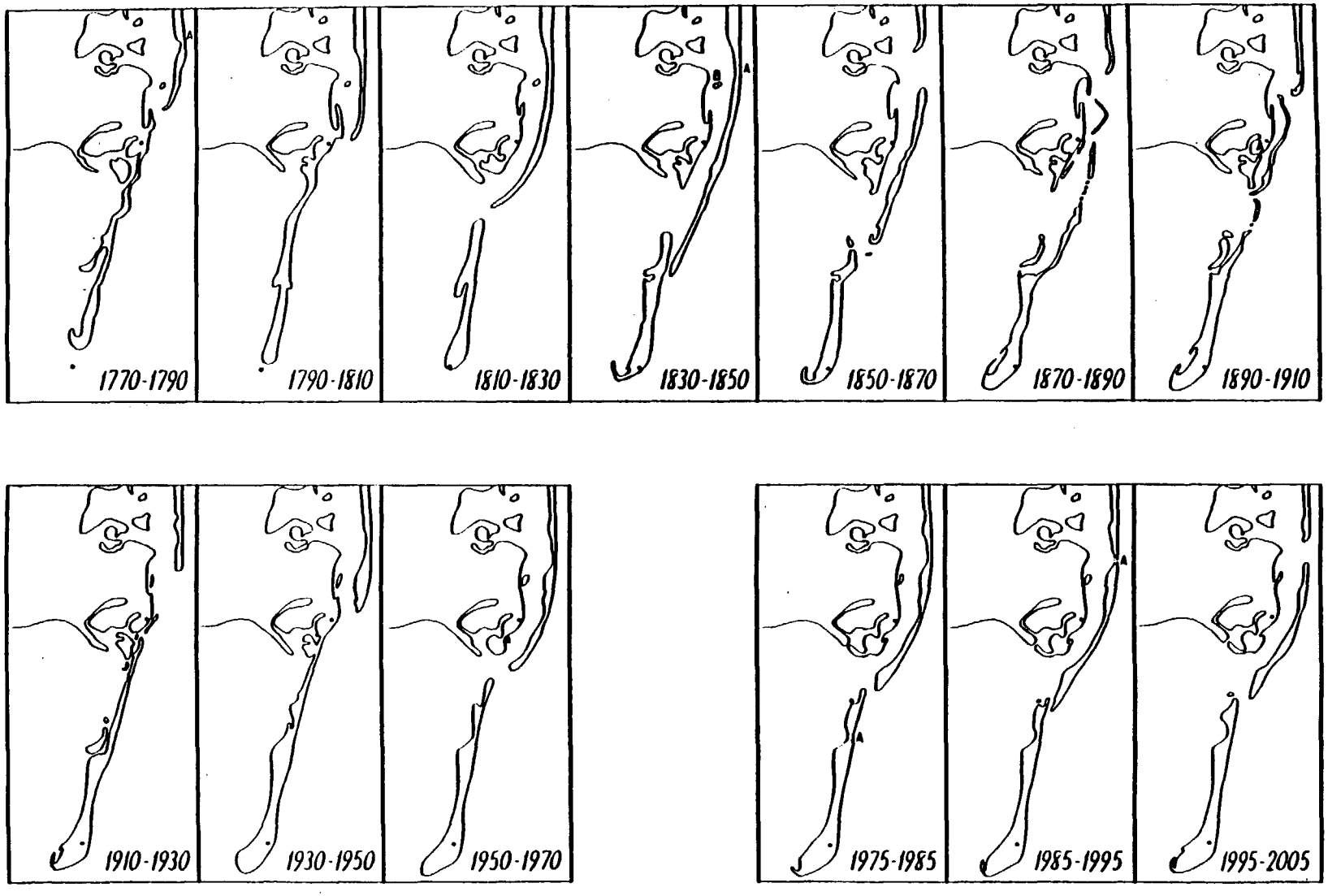
The current inlet, though closer to the fishing grounds is subject to the same wind, wave, and longshore sediment transport effects experienced in the past. Past records show that Chatham Harbor has naturally provided some deep water (12 feet or greater in many places, though it shifts often). Depths of around 4 to 6 feet at MLW, in the old inlet, were common. Today, depths across the bar in the breach fluctuate but seem to be stabilizing at 5 or 6 feet MLW. Naturally deep water still exists in portions of Chatham Harbor but severe shoaling takes place at Aunt Lydia's Cove. Fishermen, as well as recreational boaters, use higher tides and constantly monitor breach conditions before sailing. Even at times when there is sufficient navigation depths, wave conditions in the breach often keep vessels from going to sea.

Currently, conditions at Chatham most closely resemble those of 1880. South Beach is now at the beginning of its degenerative process. This degeneration process, by increasing the width of the drainage opening, could worsen navigation conditions. There is also the slim possibility of a second breach occuring somewhere north of the existing one. Two breaks actually opened during the 19th century event. There is a narrow point in Nauset Beach in the area where the breach of 1846 occurred. If this area were to breach it could have disastorous effects on navigation. Multiple inlets would provide additional drainage area, allow for more widespread shoaling of the bay, and further jeopardize navigation.

Based on the limited information available at this time it is impossible to predict the exact time and impacts on navigation of future changes in the Nauset Beach system. While it is possible to describe the future in general terms as to how the overall picture may change, specific events and their resultant effects would require constant monitoring and data collection to create a reliable forecast.

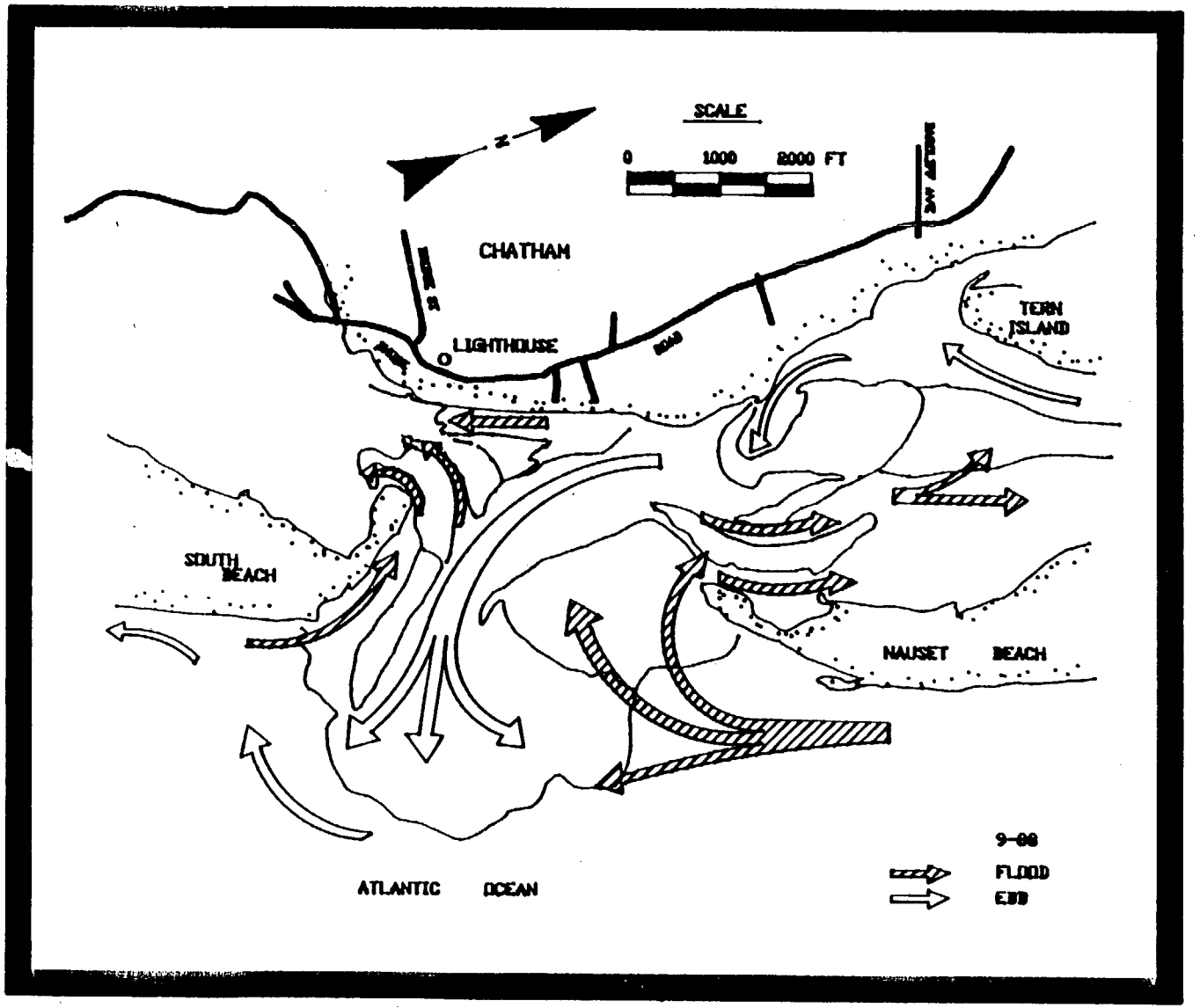
Based on available information, the following evaluative assumptions were used:

1. Since specific conditions resulting from the movement of the Nauset system cannot be predicted, for this study, the current shoaling conditions and wave climate were used.



Composite maps illustrating patterns of shoreline change in the vicinity of Chatham from 1770 to 2005 (after Giese, 1978)

ATTACHMENT #3



Hypothesized sediment transport pathways

ATTACHMENT #4

2. A controlling depth of six feet at MLW will be the without project condition at the breach.

3 A controlling depth of one foot at MLW will be the without project condition for the spar channel leading into the cove.

There are 69 commercial fishing vessels licensed to offload at the Municipal Fish Pier. Thirty-one of these vessels moor in the cove and the other 38 find mooring space outside the cove in Chatham Harbor.

Based on fleet statistics an average design vessel was calculated. This vessel would be 37 feet in length; have a 4-foot full load draft and a beam of 13 feet. This vessel size is representative of the fleet and was used to design channel and anchorage dimensions. Based on these statistics it was determined that the fleet requires approximately 7.5 acres of anchorage space.

Channel design, depth and width, are functions of the design vessel size and navigation conditions. In accordance with EM 1110-2-1615, vessel squat, 1/2 the design wave height, and safety clearance were added to the vessel's draft. This resulted in an 8-foot channel design depth. Economic analysis revealed that the fishermen actually use clearances less than the engineering design. Consideration was given to 4 and 6-foot deep channels even though they were less than the design depth. An additional two feet of underclearance was factored into those options that include a Federal channel through the breach. This was done to account for the rougher conditions in this area. The anchorage depth will equal the channel depth in all cases as conditions between the two are often similar. Due to the swirling and swift currents in Chatham Harbor it was determined that a 100-foot wide channel was necessary to provide safe, two-way access.

The wave climate in the study area was used in the design of the navigation project. The U.S. Coast Guard has kept some records that indicate that from 1988 to 1989 the depth of water through the navigable portion of the breach was never less than 5 feet deep or greater than 10 feet deep at MLW. The most recent hydrographic survey shows the breach, at its lowest point, to be 6 feet MLW. Based on this, surveys of the local fishermen, historical conditions in the Chatham Harbor inlet, and present as well as expected future conditions, a controlling depth of 6 feet at MLW was used in the breach area. The natural channel through the inlet is constantly changing due to tidal currents and wave action. Using "Atlantic Coast Hindcast, Shallow Water, Significant Wave Information" for Phase III, Station 31, a design wave, at MLW, of 2.5 feet was calculated. According to the Coast Guard, since February 1989 the breach has been classified as "rough" 41% of the time. Rough conditions are those times when at least 30% of the breach area has 2-foot or greater breakers. Waves as great as 15 feet with periods of 12 seconds can occur during periods of storm activity and high tides. Analysis shows that wave action on the average is still not excessive in the area of Aunt Lydia's Cove. The average condition produces 1-foot waves in the cove and 2-foot waves in the spar channel. Swells of up to 3 or 4 feet can be felt in the cove during periods of east or southeast storms. These gale force storms occur several times a year. Winds out of these directions are usually 20 to 40 miles per hour and can produce rough conditions for a period of three days.

Field Investigations

Field investigations were conducted during this detailed study to determine ground surface elevations, type and composition of the substrate, and other physical characteristics. This work included hydrographic surveys and sediment analysis. Based on previous studies of the area, machine probes and borings were determined to be unnecessary. The information obtained from these field investigations was used to help evaluate several plans of improvement.

a. Hydrographic Surveys: A hydrographic condition survey of the project area was conducted by the U.S. Army Corps of Engineers in January 1991. Surveys completed by Braman Engineering (May 1988) and the Corps (July 1989, December 1989, and June 1990) were compiled and used to aid in determining shoaling rates. The results of the 1991 survey are shown in Figure 2-1 of this appendix.

b. Sediment Sampling: Sediment cores and grab samples were taken by NED personnel to determine the characteristics and distribution of the soil materials within both the proposed dredging areas and the disposal sites. A total of nine sediment cores and nine grab samples (see Figure 2-2) were obtained at several locations within the study area. These samples were then analyzed at the NED Laboratory. In general, the sediment material within the dredge and disposal areas ranged from fine to medium sand. Grain size curves and chemistry results can be found in the Environmental Appendix

c. Sediment Analysis: Soil samples were visually classified in the field and verified in the laboratory using the Unified Soils Classification System (USCS). Physical testing was conducted on all samples and consisted of mechanical sieve analysis (using U.S. standard sieve sizes), specific gravity tests and hydrometer analysis wherever necessary. Grain size distribution curves and material descriptions for each of the samples can be found in the Environmental Appendix also. Chemical analysis was conducted on portions of cores "A" and "B" which contained greater than 15% fines. The results of those tests indicated low concentrations of all substances in acordance with Massachusetts criteria.

Non-Structural Solutions

1. Plan A - Transfer of the Commercial Fleet to Stage Harbor

This plan would involve transferring the commercial fishing fleet from Aunt Lydia's Cove to Stage Harbor, a highly active port also in Chatham. Stage Harbor is the site of an existing 10-foot Federal channel extending out into Nantucket Sound. The harbor is primarily recreational in nature though there is a small trap-fishing fleet based there.

Transfer of the 69 vessels now based at Aunt Lydia's Cove would involve several costs. It is estimated that approximately 14 acres of anchorage would need to be dredged to accommodate the fleet. Though mooring space is abundant during the winter months, this additional space would be needed during the recreational boating season. Based on assessor's records the town of Chatham owns approximately 3.4 acres of land in the area of Old Mill

Boatyard on which development could take place. The town owned property at Aunt Lydia's Cove is approximately 2.2 acres in size. Based on available area, the Municipal Pier operations could be transferred to Stage Harbor without the purchase of land. However, this action would involve the cost of constructing a new facility. There are two private piers operating next to Old Mill Boatyard. These facilities are not capable of handling the type of fishing fleet that would be transferred. The cost of a new facility is based on the 1989 assessment of the property at the cove. The initial cost of implementing this plan is estimated as follows:

Municipal Fish Pier Replacement: (Includes buildings, parking, bulkheads)	$600,000
Anchorage Dredging: 14 acres @ $8.00/cy	$360,000
Total Cost:	$960,000

This estimate does not include any road or utility improvements which may be needed. The estimate was made assuming that a commercial facility in this area could be built within the framework of local zoning laws and that the dredging required would be environmentally acceptable.

Structural Solutions

1. Plan B - Channel South of Tern Island

This plan involves establishing a Federal anchorage and channel at Aunt Lydia's Cove. The layout follows the traditional route south of Tern Island. Based on engineering criteria, an 8-foot deep by 100-foot wide channel was found to be the optimum design. Cost estimates were performed for the 4, 6, and 8-foot depths. The size of the anchorage is 7.5 acres and an additional 2 acres of space is needed as a berthing and maneuvering area. The layout of the general plan can be seen in Figure 2-3. The channel was laid out in such a way as to take advantage of the flushing currents in the cove and ebb channel in Chatham Harbor.

All dredging in the cove and spar channel would be performed by a 10-inch hydraulic dredge. Initial estimates reflect a plan whereby the material would be pumped to a confined disposal facility (CDF), on Tern Island, for disposal. It is estimated that the capacity of the CDF would be sufficient for yearly maintenance of each alternative. Other methods of disposal considered included: placement of the material unconfined on Tern Island, pumping it to North or Lighthouse beaches, or removing it by mechanical dredge and scow. Each method had its own set of limitations and costs.

Dredging in the breach or the more exposed portions of Chatham Harbor would be accomplished by hydraulic hopper dredge due to the wave conditions prevalant in that area. Material picked up by the hopper dredge would be dumped outside and south of the breach. Costs for the various alternatives can be found in Tables 2-2 and 2-3.

3. Plan C - Channel North of Tern Island

This plan is similar to the previous one except in this case the channel would be routed around the north end of Tern Island (see Figure 2-3). The

dredged channel would pass through some extensive tidal flats to the north of the cove to reach the ebb channel to the east of Tern Island. The advantage of this plan is that the channel would use the island as a shield; protecting it from some of the shoaling and wave attack attributed to the breach. Cost estimates for this plan can be found in Table 2-3.

4. Plan D - Breakwater Structure Alone

This plan would involve providing a wave dampening structure at the south end of Aunt Lydia's Cove. The structure's purpose is to protect the cove area from damaging wave and swell attack. Analysis of the area determined that swells with periods in excess of 3 seconds were the major cause of damage to vessels and the pier. A wavefence was considered but determined to be not as effective for this size wave. A small breakwater was no more costly and has proven to be the more dependable structure for this situation. Layout of this plan can be seen in Figure 2-4 and 2-6. The cost estimate can be found in Table 2-4.

5. Plan E - Channel and Jetty Combination

This plan would involve combining a channel, south of Tern Island, with a stone or rubble-mound jetty. The purpose of this plan is to provide a channel and basin area that is protected from sea swell and whose annual shoaling rate is slightly reduced. It was determined that the jetty would "bottle-up" some of the shoaling material behind it and protect the cove at the same time. Though the plan is designed to take advantage of Chatham Harbor's deep water ebb channel, its effectiveness is limited. Shifting sand would make its way around the jetty's head, causing a shoal to form at its entrance. In order to make this plan more effective, it was determined that the southern end of Tern Island would need to be protected from erosion. Introducing a jetty into the area would cause increased scouring forces on the island's southern tip. A stone revetment, placed around the southern edge of the island above the high tide line, was seen as an effective way of stabilizing the area against further erosive forces. A layout of the plan and its typical cross section can be found in Figure 2-5 and 2-6. Costs for this plan can be found in Table 2-5.

The design of Plans D or E is based on conditions experienced over the last four years. The usefulness of these structures would be lost if further retreat of Nauset Beach occurred and the ocean's angle of attack changed. It is impossible to design structures such as these to be flexible and account for a wide variety of possible future conditions. The introduction of hard structures into this very dynamic situation also raises questions as to interaction with and impact to the surrounding land features and current patterns. These are issues that have not been resolved at this level of study. However, for purposes of cost comparison the alternatives were included in the report.

Material Quantities

The ordinary material to be dredged for plans B, C, and E is primarily fine and medium sand. Detailed study, including type and exact quantity of material to be removed under Plan A was not conducted due to the limited funding. There would be no need of rock removal for any plan considered in the study. Quantities of material to be dredged for all of the plans of improvement considered in this study can be found in Table 2-1. The table includes quantities for dredging with and without the breach. The plans including a breach channel are based on an additional 2 feet of channel depth i.e. an 8-foot channel would mean dredging to 10 feet in the breach. Economic analysis will explore the completeness of these variations. To allow for dredging inaccuracies, the quantities shown include one foot of overdepth dredging. Dredging quantities were computed from the Corps' hydrographic survey of January 1991 (Figure 2-1) assuming a typical trapezoidal channel cross-section with 1 on 3 side slopes.

Table 2-1
Quantities of Material to be Removed (Cubic Yards)

	Total Including Allowable Overdepth
Plan B1 (including breach)	
4' Anchorage and Channel	20,100
6' Anchorage and Channel	58,900
8' Anchorage and Channel	133,600
Plan B2 (excluding breach)	
4' Anchorage and Channel	20,100
6' Anchorage and Channel	46,900
8' Anchorage and Channel	86,500
Plan C1 (including breach)	
4' Anchorage and Channel	74,600
6' Anchorage and Channel	147,400
8' Anchorage and Channel	261,100
Plan C2 (excluding breach)	
4' Anchorage and Channel	74,600
6' Anchorage and Channel	135,400
8' Anchorage and Channel	214,000
Plan E (Jetty and Channel)	
Anchorage and Channel (south of Tern Island)	94,600

Cost Estimates

Construction cost estimates were prepared for all the alternatives mentioned above. All cost estimates were computed using 1991 price levels and include contractor markup, Preconstruction Engineering & Design (PE&D) costs, Construction Management (CM) costs, and contractor mobilization and demobilization. Cost estimates for the channel alternatives include both

the with and without breach portion dredging. The cost for dredging the anchorage and spar areas is based on a 10" hydraulic cutterhead dredge plant working 10 hours per day, 6 days per week. Estimates for all breach dredging are based on a small class hopper dredge plant working 24 hours per day, 7 days per week. The alternative E estimate was based on a channel and anchorage depth of 8 feet.

A detailed estimate of the 8-foot option of Plan B1 is shown in Table 2-2. However, in order to avoid repetition, a summary of the cost estimates is shown in Table 2-3.

A contingency factor has been added to each cost estimate to account for potential increases during the preparation of plans and specifications. More detailed information regarding quantities and equipment, labor, and fuel costs are required before a more accurate estimate can be prepared. All of this information would be obtained during the preparation of plans and specifications. At that time the contingency factor will be decreased as the level of detailed information increases.

As previously mentioned, several disposal alternatives are potentially available, each having its own variables for long-term use and cost. A 6-acre confined disposal facility was initially examined as it provides a long term strategy for disposal of the material. The initial construction cost of the CDF is estimated at $36,000. This includes construction of 2000 linear feet of sand retaining dike, a discharge facility, and the planting of beach grass along the dike crest and outer slope to help stabilize the area against erosion. Material now at the site would be used to initially build the retaining dike. The dike crown would be 10 feet wide at an elevation of 13 feet above MLW. The dike side slopes would be 1 vertical on 4 horizontal. The capacity of the CDF, with an interior base elevation of 5 feet above MLW (4-foot lift), would be approximately 30,000 cy. A typical cross section of this disposal site can be seen in Figure 2-7. This capacity would provide sufficient storage for yearly maintenance dredging for each plan. For initial construction and subsequent maintenance activities where quantities exceed the CDF capacity, surplus material would need to be placed upland on the north and east sides of Tern Island.

Aids to Navigation

Specific costs for aids to navigation will be obtained from the U.S. Coast Guard, who will be responsible for placing and maintaining any aids they deem necessary for boating safety. For the purpose of this study it was assumed that six additional steel can buoys will be needed for the channel that runs north of Tern Island. The initial cost of providing these aids is estimated at $3,000 per buoy. No costs are shown for aids to navigation for channel plans south of Tern Island since they already exist.

Table 2-2

First Cost of Federal Improvement

Plan B1 - Channel South of Tern Island (Including Breach)

8-Foot Depth:	
Dredging Ordinary Material:	
Spar Channel & Anchorage 86,500cy @ 4.15/cy	$359,000
Breach Channel 47,100cy @ 6.75/cy	318,000
Contingencies	135,000
SUBTOTAL	$812,000
Preconstruction Engineering & Design	53,000
Construction Management	82,000
TOTAL FIRST COST	$947,000
Interest During Construction (4.0 months)	11,000
Aids to Navigation: 0 @ $3,000 ea	0
TOTAL INVESTMENT	$958,000

Table 2-3

Summary of First Costs For Dredging Plans

Project Depth	PLAN B1	PLAN B2	PLAN C1	PLAN C2
4-Foot Depth	$267,000	$267,000	$558,000	$558,000
6-Foot Depth	$688,000	$374,000	$1,122,000	$804,000
8-Foot Depth	$958,000	$525,000	$1,609,000	$1,167,000

Table 2-4

First Cost of Federal Improvement

Plan D - Breakwater South of Tern Island

Rubble Mound Breakwater: 175 LF @ $1,800/LF	$315,000
Contingencies	63,000
SUBTOTAL	$378,000
Preconstruction Engineering & Design	56,000
Construction Management	40,000
TOTAL FIRST COST	$474,000
Interest During Construction (3 months)	4,000
TOTAL INVESTMENT	$478,000

Table 2-5

First Cost of Federal Improvement

Plan E - Jetty & Channel South of Tern Island

Rubble Mound Jetty: 900 LF @ $1,800/lf	$1,620,000
Stone Revetment: 1,000 LF @ $1,000/lf	1,000,000
Dredging Ordinary Material:	
Spar Channel & Anchorage 94,600cy @ 4.15/cy	$ 393,000
Contingencies	603,000
SUBTOTAL	$3,616,000
Preconstruction Engineering & Design	113,000
Construction Management	248,000
TOTAL FIRST COST	$3,977,000
Interest During Construction (12 months)	166,000
TOTAL INVESTMENT	$4,143,000

Maintenance Costs

Maintenance of a Federal project to authorized dimensions is necessary to ensure project benefits are achieved.

After initial construction dredging, the areas of improvement would shoal or fill-in due to deposition of material eroded from upland regions, littoral drift from the breach, settlement of side slope material, and redistribution of bottom sediments by tidal currents. Although channel side slopes are designed and shaped in such a way as to enhance stability, changes to the bottom contours will occur quickly, resulting in the flattening of these slopes and shoaling of the channel and anchorage. Strong current action occurring on a daily basis will also result in the movement of bottom sediments as will the effects of wave action and propeller wash.

Since the breach occurred in 1987 large amounts of sediment from Nauset Beach and eroded material from the shoreline have and continue to be moved about in Chatham Harbor. The Aunt Lydia's Cove area has been extremely hard hit by the deposition of this material. Longshore sediment transport rates were calculated for the Nauset Beach area during the previous study. This information indicates the magnitude of material being moved across the breach area. Erosion material from the breach and the Chatham shoreline both contribute to the process, but how much from each is unknown. Recent information indicates that the shoreline continues to erode in those areas where property has not been provided with substantial protection. Nauset Beach also appears to still be eroding, though at a slower rate. Previous studies indicate that significant growth of Nauset Beach would not occur for another 30 to 50 years. Existing conditions are likely to be experienced over that period. Therefore, for purposes of this study, average shoaling rates, of the magnitude currently experienced, were used.

Hydrographic information obtained over the last three years was used to quantify estimated annual shoaling rates. Though not exact this method was determined to be the best way of quantifying the very dynamic shoaling processes in the area. The following annual shoaling rates were used in our analysis:

Plan B - 21,400/year
Plan C - 19,600/year
Plan E - 11,400/year

The above mentioned shoaling rates are an average.

Critical shoal areas will develop under each dredging plan. For instance, shoaling at the mouth of the spar channel occurs on the average of 6 inches per month, though sometimes even more quickly as a result of storms. Within a year of dredging the spar channel area shoals to a depth of -1 MLW. Critical shoal areas will develop at the entrance of the channels north of Tern Island and the jetty plan also, but at only half the the rate. These entrances are estimated to shoal-in on the order of 3 or 4

feet per year. Within months of any dredging option, it is expected shoaling will again cause the fishing fleet navigation delays and damages. Based on these shoaling rates, several dredging operations per year will be needed to maintain the desired project depths. Plan B is estimated to need dredging every four months and plans C and E every eight months.

Based on current operation and maintenance practices at New England Division, a realistic Corps' maintenance schedule would be once every three years. Guaranteed yearly maintenance dredging by the Corps is nearly impossible under standard operating procedures. This is due to conflicts in scheduling, limited budget resources, and delays resulting from contractors and the permitting process. Other Federal projects in the New England area that experience shoaling rates even remotely close to these are not maintained on a yearly basis. Initially, three year cycle maintenance costs were considered. However, the shoaling rates that were found to exist require that several dredge operations per year are needed to maintain each of the considered dredging plans. Waiting every three years to dredge would in fact lead to the failure of each channel due to the development of critical shoals.

In order to achieve annual, or in this case several maintenance operations during the course of a year, an initial plan to station a dredge plant at the cove was formulated. Annual costs for this are based on an initial purchase price, for a portable 10" hydraulic cutterhead dredge, of $350,000. Ownership costs translate into $30,000 a year. Additional costs for operating the dredge including labor, preconstruction engineering, and construction management of the work, were included in the estimate. This method of maintaining the project was seen as the least costly way in which several dredge events could be done during the year.

Costs to the local sponsor to empty the confined disposal site every year were also considered. The estimate is based on removing the dredge material, loading it into a 1,500 cy scow and transporting it by tug to provide beach nourishment. Due to the uncertainty of the amount and frequency of future maintenance, it was estimated that the CDF would need to be emptied every year and a half. Due to the lower amounts of maintenance material associated with the jetty alternative, emptying of the CDF could be done every three years. Transport by scow was determined to be the most efficient way of rehandling the material and using it in a beneficial way.

Project maintenance costs for the implementation of stationing a dredge and operating the CDF can be found in Table 2-6 thru 2-9. The three year maintenance estimates are based on contracted dredging costs. Unit prices for maintenance dredging in the breach are based on one-time, contracted prices.

Due to the possibility of implementational and environmental restrictions with the disposal options described thus far, several alternative disposal methods were briefly examined.

Alternate use of the material placed in the CDF either for the rebuilding of Tern Island or nearby shore placement was considered. This is certainly a less expensive method for disposal than the tug and scow scheme that was looked at. However, this plan does not offer a long term strategy for

dredged material disposal. The anticipated amount of dredged material appears to far outweigh Tern Island's yearly nourishment need. In addition, both this and beach nourishment adjacent to the cove are seen as very counterproductive and shortlived solutions (especially for plans B and E) as the material would erode and be swept back into the channel quickly.

Disposal variations such as pumping the material to Nauset Beach or the eroded shoreline areas toward Lighthouse Beach were also looked at. The use of Nauset Beach as a long term disposal site is suspect because it is within the boundaries of the Cape Cod National Seashore. The estimate for hydraulically pumping (by contractor) 7,000 cy of material 1.5 miles is approximately $205,000. Pumping 13,000 cy of material is estimated to cost $210,000. For Plan B (three maintenance operations per year) this would translate into a total annual maintenance cost of $615,000. For Plan C and E (one and a half maintenance operations per year) this would translate into a total annual maintenance cost of $315,000 and $308,000 respectively.

Another method investigated involved mobilizing a mechanical dredge to conduct the maintenance work. This option would be similar to the hydraulic method in that it would involve contracting for several dredgings per year. However in this case the dredged material would be loaded directly onto a barge and towed to erosion sites along the shore, 1.5 miles south of the cove. The estimate for mechanically dredging (by contractor) 7,000 cy of material and towing it 1.5 miles is $225,000. Mechanically removing 13,000 cy of material the same distance is estimated to cost $390,000. For Plan B this would translate into a total annual maintenance cost of $675,000. For Plan C and E this would translate into a total annual maintenance cost of $585,000 and $338,000 respectively.

Based on this analysis, stationing of a dredge on site in conjunction with the confined disposal facility on Tern Island provides the least costly maintenance alternative. This is only logical as it allows quick and frequent response to a very dynamic situation. While it is less expensive to just dispose of the material on Tern Island, this does not provide a long term solution for the disposal needs. Because of this, the costs for removing the material to several different sites were explored.

Table 2-6

Project Maintenance

Plan B1 - Channel South of Tern Island (Including Breach)

4-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 21,400 cy @ $8.05/cy	$172,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$282,000
TOTAL 3rd YEAR MAINTENANCE COST	$561,000
6-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 21,400 cy @ $8.05/cy	$172,000
Breach Channel: 5,700 cy @ $55.00/cy	314,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$596,000
TOTAL 3rd YEAR MAINTENANCE COST (includes breach dredging)	$821,000
8-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 21,400 cy @ $8.05/cy	$172,000
Breach Channel: 17,000 cy @ $20.00/cy	340,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$622,000
TOTAL 3rd YEAR MAINTENANCE COST (includes breach dredging)	$842,000

Plan B2 - Channel South of Tern Island (Excluding Breach)

4-Foot Depth: (same as above)	
6-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 21,400 cy @ $8.05/cy	$172,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$282,000
TOTAL 3rd YEAR MAINTENANCE COST	$561,000
8-Foot Depth: (similar to 6-foot depth)	

Table 2-7

Project Maintenance

Plan C1 - Channel North of Tern Island (Including Breach)

4-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 19,600 cy @ $8.70/cy	$171,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$281,000
TOTAL 3rd YEAR MAINTENANCE COST	$469,000
6-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 19,600 cy @ $8.70/cy	$171,000
Breach Channel: 5,700 cy @ $55.00/cy	314,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$595,000
TOTAL 3rd YEAR MAINTENANCE COST (includes breach dredging)	$783,000
8-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 19,600 cy @ $8.70/cy	$171,000
Breach Channel: 16,700 cy @ $20.00/cy	334,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$615,000
TOTAL 3rd YEAR MAINTENANCE COST (includes breach dredging)	$804,000

Plan C2 - Channel North of Tern Island (Excluding Breach)

4-Foot Depth: (same as above)

6-Foot Depth:	
Annual Maintenance	
Channel & Anchorage: 19,600 cy @ $8.70/cy	$171,000
Confined Disposal Facility (non-Federal cost)	110,000
TOTAL ANNUAL MAINTENANCE COST	$281,000
TOTAL 3rd YEAR MAINTENANCE COST	$469,000

8-Foot Depth: (similar to 6-foot depth)

Table 2-8

Project Maintenance

Plan D - Breakwater South of Tern Island

Annual Maintenance	
Breakwater: $1,000 L.S.	$ 1,000
TOTAL ANNUAL COST	$ 1,000

Table 2-9

Project Maintenance

Plan E - Jetty and Channel South of Tern Island

Annual Maintenance	
Channel & Anchorage: 11,400 cy @ $13.85/cy	$158,000
Confined Disposal Facility (non-Federal cost)	55,000
Jetty: $10,000 L.S.	10,000
TOTAL ANNUAL COST	$223,000
TOTAL 3rd YEAR MAINTENANCE COST	$379,000

CORPS OF ENGINEERS — U. S. ARMY

N255000 — N254000

E 1021000 — E 1024000 — E 1023000

N253000

APDITIONAL DISPOSAL AREA 2

℄ of Retaining Dike

TERN ISLAND

ALTERNATE DISPOSAL
(CONFINED DISPOSAL FACILITY)

NORTH (1989)

MEAN HIGH WATER LINE

AUNT LYDIA'S COVE

MEAN LOW WATER (MLW)

PIPE (1990)

RN2 RN4 RN6 RN8

GC1 GC1A GC3 GC5

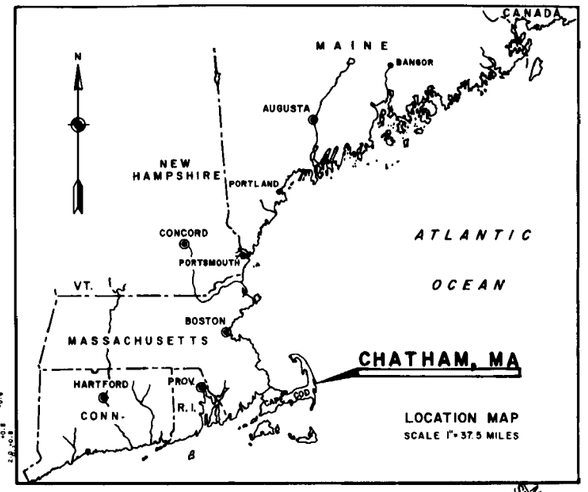
100'

7435C

T.P. LITE POLE (89)

Flood
Ebb

MATCH SHEET "2" LINE OF



PLAN
SCALE 1"=100'

GRAPHIC SCALES
1"=37.5 MI: 25 0 25 50 75 MI.
1"=100': 100' 0 100' 200'

GENERAL NOTES:

Soundings are in feet and tenths and are referred to the plane of Mean Low Water (M.L.W.)

Bench Mark Data: B.M. 7435C dated 1989 is a National Ocean survey disk set in the concrete walkway at the northeast corner of the Chatham fish pier.

Elevation transferred from B.M.#4 at Stage Harbor is 9.84 feet above M.L.W.

Coordinates are based on the Lambert Grid System for state of Massachusetts (Mainland Zone).

The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

The sounding information depicted on these maps represents the "shoalest" soundings of those obtained from hydrographic surveys conducted during December 1990 & January 1991. This information should should NOT be used to determine volumes.

Field book: R & H 4345.

Depthsounder Rolls: 91-9 thru 91-13

Survey by Preston & party.

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: PROJECT MANAGER

REVIEWED: CHIEF, COASTAL ENG./PLAN SECT.

APPROVAL RECOMMENDED: CHIEF, DESIGN BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION — DATE

PROJ. NO. 94.0

AUNT LYDIAS COVE & CHATHAM HARBOR
CHATHAM, MASSACHUSETTS
CONDITION SURVEY

SCALE AS SHOWN | SPEC. NO. DACW 33

DRAWING NUMBER

FIGURE 2-1A

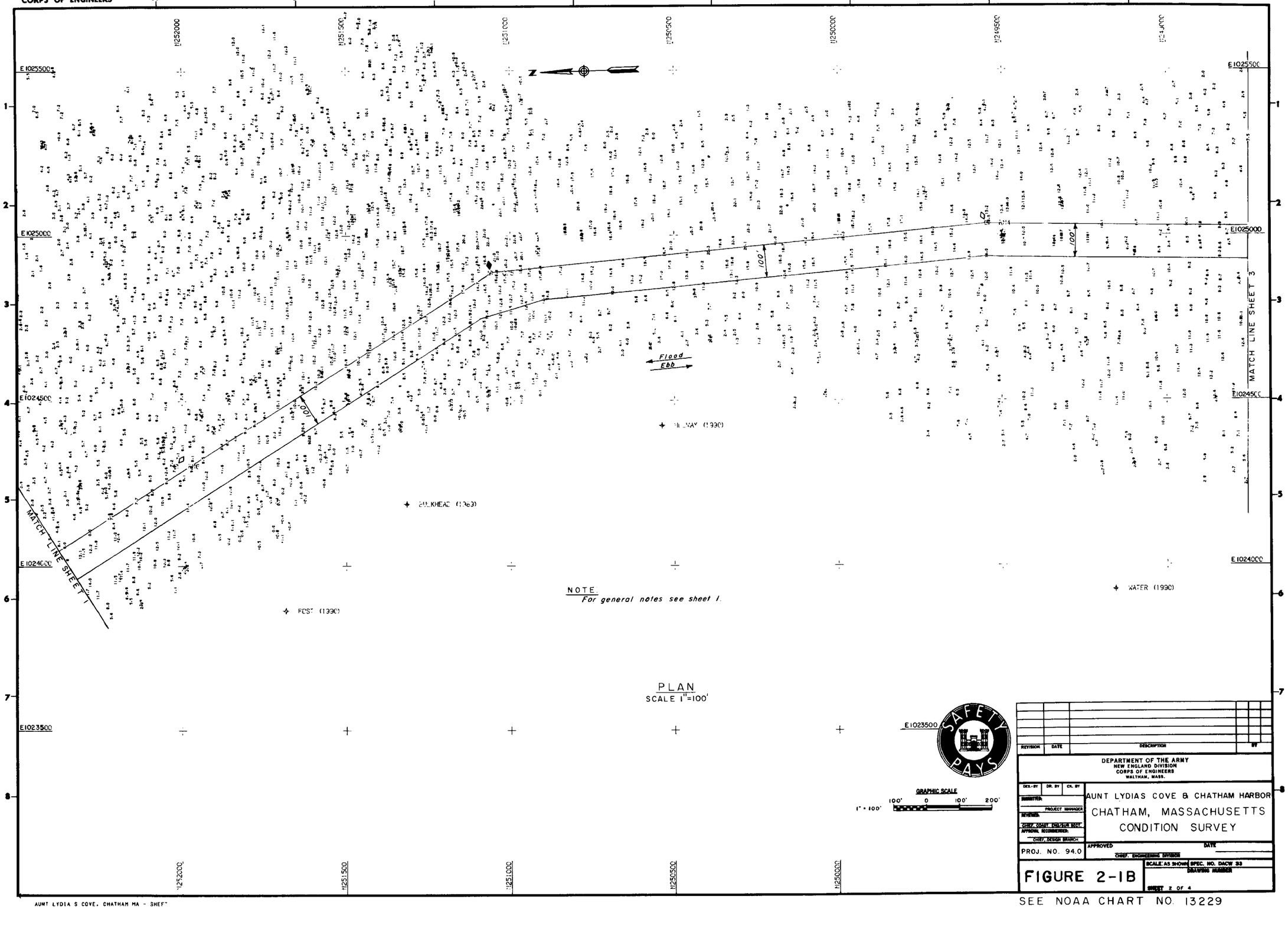
SHEET 1 OF 4

AUNT LYDIA'S COVE, CHATHAM MA -

SEE NOAA CHART NO. 13229

CORPS OF ENGINEERS

U. S. ARMY



NOTE
For general notes see sheet 1.

PLAN
SCALE 1"=100'

GRAPHIC SCALE
1" = 100'
100' 0 100' 200'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED
PROJECT MANAGER
REVIEWED
CHIEF, COAST. ENGR/SUR BRCH.
APPROVAL RECOMMENDED
CHIEF, DESIGN BRANCH

AUNT LYDIAS COVE & CHATHAM HARBOR
CHATHAM, MASSACHUSETTS
CONDITION SURVEY

PROJ. NO. 94.0

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN SPEC. NO. DACW 33
DRAWING NUMBER

FIGURE 2-1B

SHEET 2 OF 4

SEE NOAA CHART NO. 13229

CORPS OF ENGINEERS

U. S. ARMY

A B C D E F G H

MATCH LINE SHEET 4 OF 4

MATCH LINE SHEET 2 OF 4

N248000 N247000 N246000

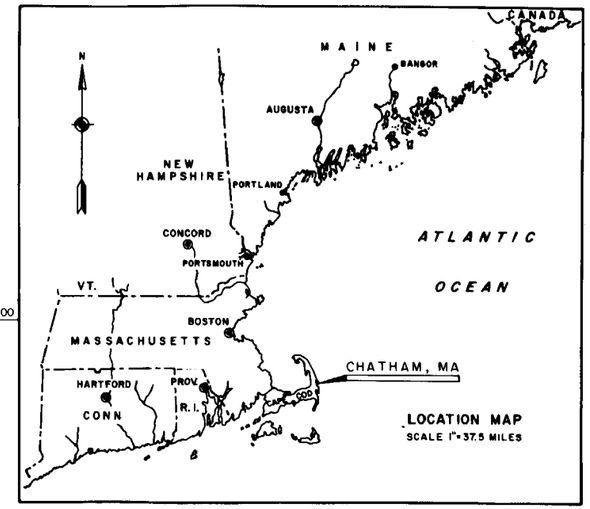
E1026000 E1025000

1 2 3 4 5 6 7 8

BREACH CHANNEL

Flood
Ebb

100'



PLAN
SCALE 1" = 100'

NOTE:
For general notes see sheet 1.

GRAPHIC SCALES
1"=37.5MI 25 0 25 50 75 MI.
1"=100' 100' 0 100' 200'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: PROJECT MANAGER

REVIEWED: CHIEF, COAST. CONS/SUR SECT.

APPROVAL RECOMMENDED: CHIEF, DESIGN BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION DATE

PROJ. NO. 94.0

AUNT LYDIAS COVE & CHATHAM HARBOR
CHATHAM, MASSACHUSETTS
CONDITION SURVEY

SCALE AS SHOWN SPEC. NO. DACW 33

DRAWING NUMBER

FIGURE 2-1C

SHEET 3 OF 4

AUNT LYDIA S COVE, CHATHAM MA

SEE NOAA CHART NO. 13229

CORPS OF ENGINEERS

U. S. ARMY

A B C D E F G H

N247000 N246000 N245000

E1029000 E1028000 E1027000

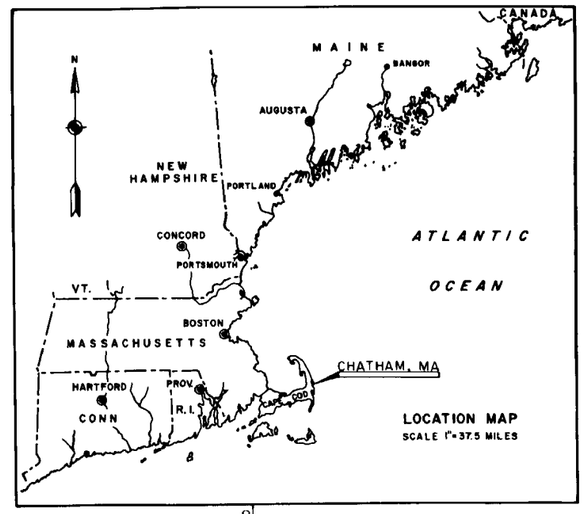
N1027000

N244000

1 2 3 4 5 6 7 8

BREACH CHANNEL

Flood
Ebb



LOCATION MAP
SCALE 1"=37.5 MILES

PLAN
SCALE 1"=100'

NOTE:
For general notes see sheet 1.

GRAPHIC SCALES
1"=37.5MI. 25 0 25 50 75MI
1"=100' 100' 0 100' 200'

SAFETY PAYS

MATCH LINE SHEET 3 OF 4

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
PROJECT MANAGER
REVIEWED:
CHIEF, COASTL ENG/EUR SECT.
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH

AUNT LYDIAS COVE & CHATHAM HARBOR
CHATHAM, MASSACHUSETTS
CONDITION SURVEY

APPROVED DATE
CHIEF, ENGINEERING DIVISION

PROJ. NO. 940

SCALE AS SHOWN | SPEC. NO. DACW 33
DRAWING NUMBER

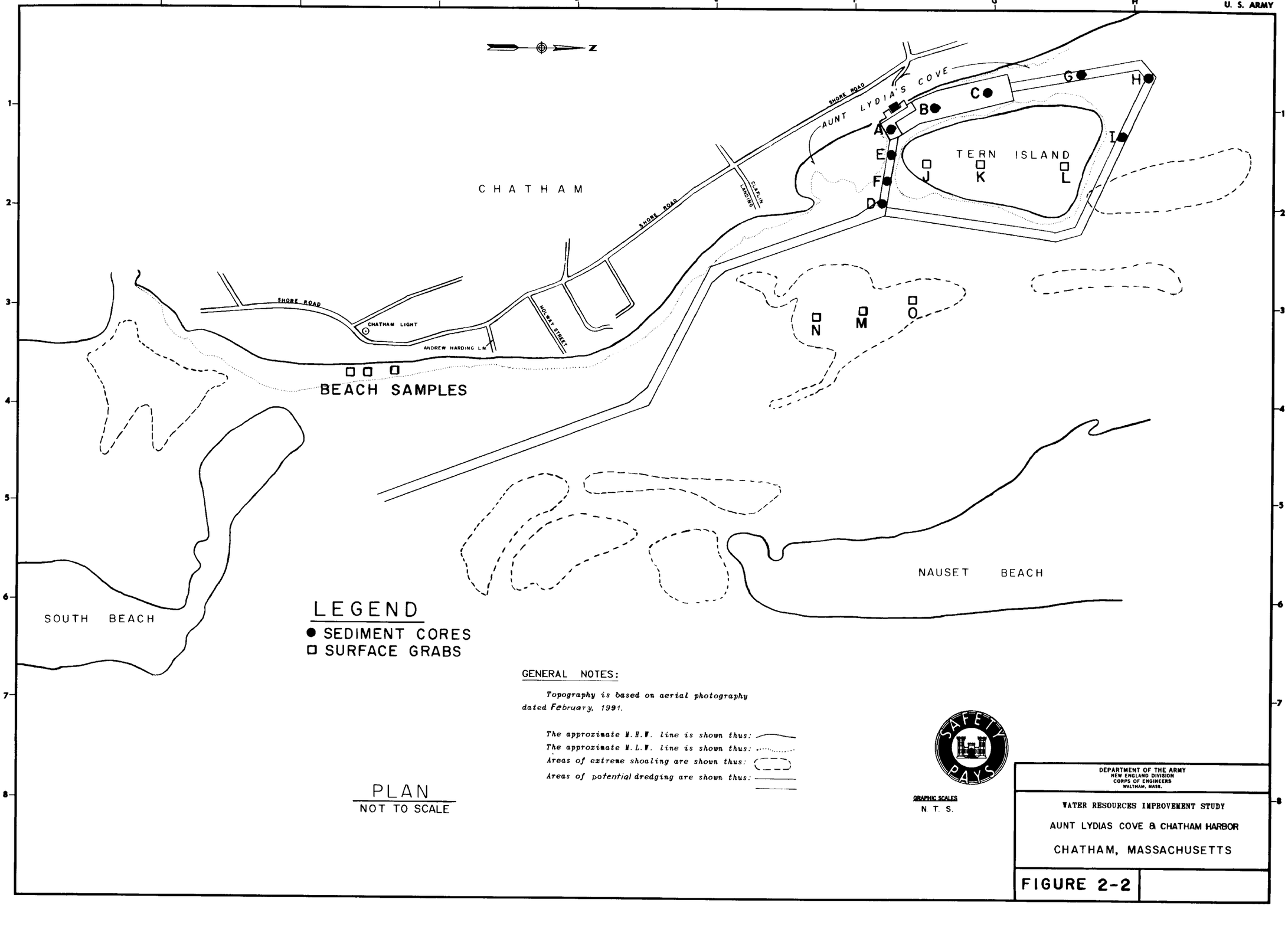
FIGURE 2-1D

SHEET 4 OF 4

SEE NOAA CHART NO. 13229

AUNT LYDIA'S COVE, CHATHAM MA

CORPS OF ENGINEERS — U. S. ARMY



LEGEND

- ● SEDIMENT CORES
- □ SURFACE GRABS

GENERAL NOTES:

Topography is based on aerial photography dated February, 1991.

The approximate M.H.W. line is shown thus: ~~~~

The approximate M.L.W. line is shown thus: .....

Areas of extreme shoaling are shown thus: (- - -)

Areas of potential dredging are shown thus: ———

PLAN
NOT TO SCALE

GRAPHIC SCALES
N. T. S.

SAFETY PAYS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES IMPROVEMENT STUDY

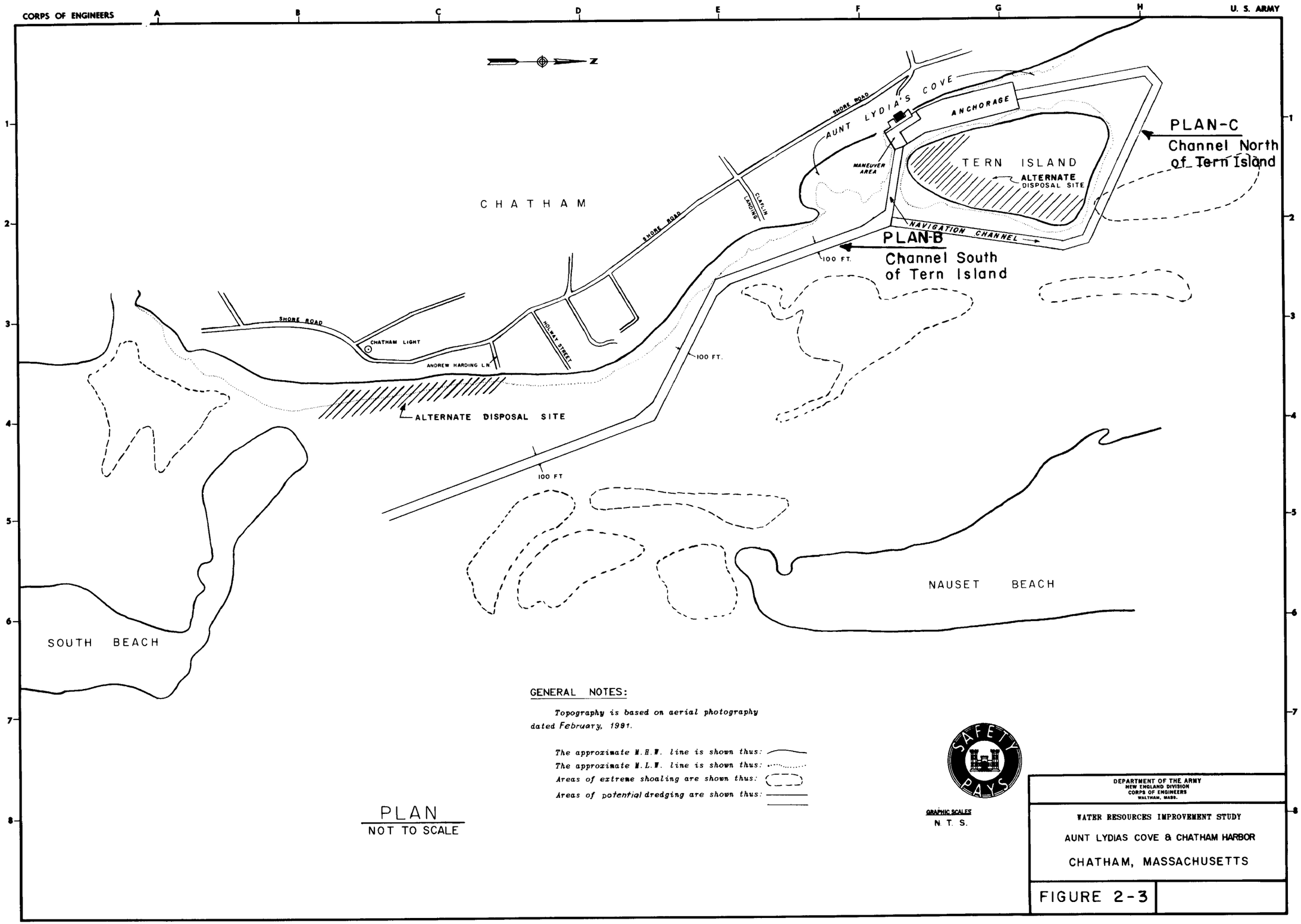
AUNT LYDIAS COVE & CHATHAM HARBOR

CHATHAM, MASSACHUSETTS

FIGURE 2-2

CORPS OF ENGINEERS

U. S. ARMY



PLAN
NOT TO SCALE

GENERAL NOTES:

Topography is based on aerial photography dated February, 1981.

The approximate M.H.W. line is shown thus:

The approximate M.L.W. line is shown thus:

Areas of extreme shoaling are shown thus:

Areas of potential dredging are shown thus:

GRAPHIC SCALES
N. T. S.

SAFETY PAYS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES IMPROVEMENT STUDY

AUNT LYDIAS COVE & CHATHAM HARBOR

CHATHAM, MASSACHUSETTS

FIGURE 2-3

CORPS OF ENGINEERS

U. S. ARMY

A B C D E F G H

N255000

N254000

E 1024000

E 1023000

N253000

1 2 3 4 5 6 7 8

N

TERN ISLAND

NORTH (1989)

MEAN HIGH WATER LINE

AUNT LYDIA'S COVE

PLAN D

RUBBLEMOUND BREAKWATER
175' LONG CREST @ ELEV. + 8.0' M.L.W.

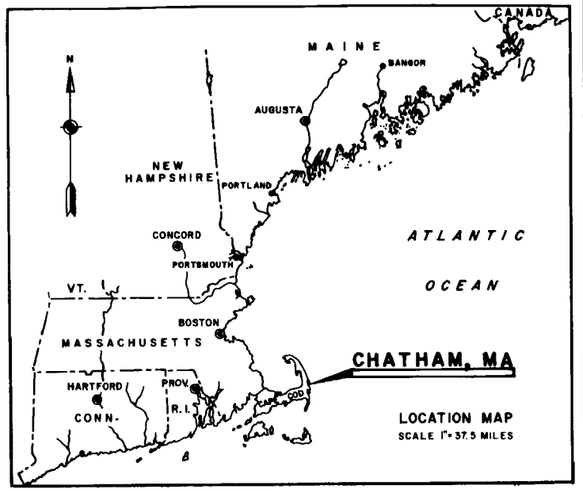
7435C

Flood
Ebb

MUNICIPAL
FISH PIER

T.P. LITE POLE (89)

PLAN
SCALE 1" = 100'



GRAPHIC SCALES

1"=37.5MI 25 0 25 50 75MI

1"=100' 100' 0 100' 200'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: PROJECT MANAGER

REVIEWED: CHIEF, COAST. ENG/HAR. SECT.

APPROVAL RECOMMENDED: CHIEF, DESIGN BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION — DATE

AUNT LYDIAS COVE & CHATHAM HARBOR
CHATHAM, MASSACHUSETTS
CONDITION SURVEY

PROJ. NO. 94.0

FIGURE 2-4

SCALE AS SHOWN | SPEC. NO. DACW 33

DRAWING NUMBER

SHEET 1 OF 4

AUNT LYDIA'S COVE, CHATHAM MA -

SEE NOAA CHART NO. 13229

CORPS OF ENGINEERS — U. S. ARMY

B C D E F G H

N255000 N254000

1 2 3 4 5 6 7 8

E 1024000 E 1023000

N

ADDITIONAL DISPOSAL AREA

℄ of Retaining DIKE

TERN ISLAND

ALTERNATE DISPOSAL
(CONFINED DISPOSAL FACILITY)

NORTH (1989)

MEAN HIGH WATER LINE

AUNT LYDIA'S COVE

PLAN E

RUBBLEMOUND JETTY - ELEV. +8.0' M.L.W.
W/6' DEEP CHANNEL & ANCHORAGE

600'

300'

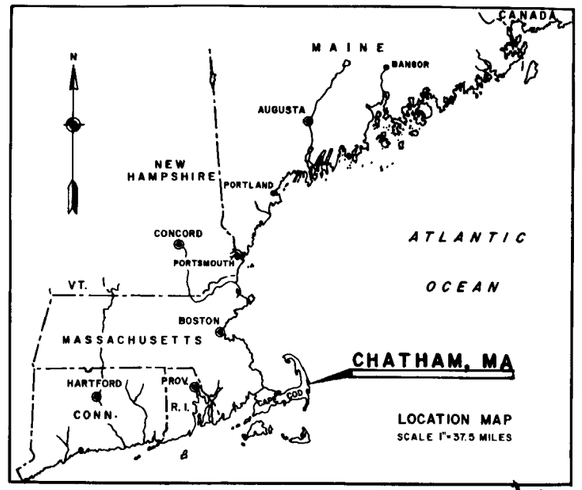
7435C

Flood
Ebb

T.P. LITE POLE (89)

PLAN
SCALE 1" = 100'

MATCH LINE FIG. 2-1A



SAFETY PAYS

GRAPHIC SCALES
1"=37.5MI. 25 0 25 50 75MI.
1"=100' 100' 0 100' 200'

N253000

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: PROJECT MANAGER

REVIEWED: CHIEF, COAST. ENG/SUR SECT.

APPROVAL RECOMMENDED: CHIEF, DESIGN BRANCH

APPROVED DATE
CHIEF, ENGINEERING DIVISION

PROJ. NO. 94.0

AUNT LYDIAS COVE & CHATHAM HARBOR
CHATHAM, MASSACHUSETTS
CONDITION SURVEY

SCALE AS SHOWN | SPEC. NO. DACW 33

DRAWING NUMBER

SHEET 1 OF 4

FIGURE 2-5

AUNT LYDIA'S COVE, CHATHAM MA -

SEE NOAA CHART NO. 13229

TYPICAL BREAKWATER/JETTY SECTION

NTS

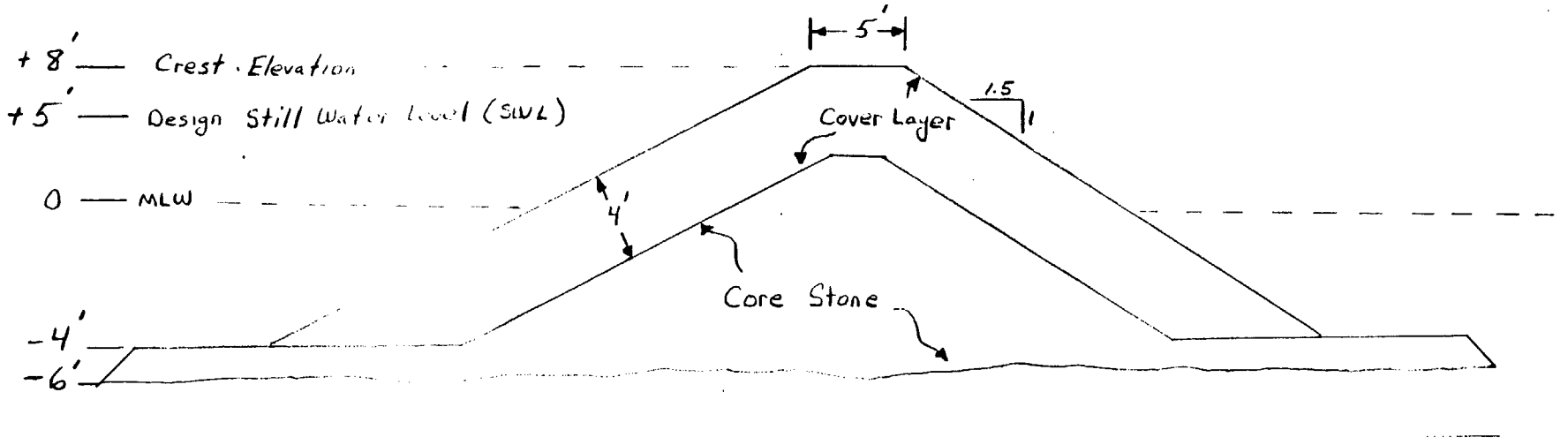
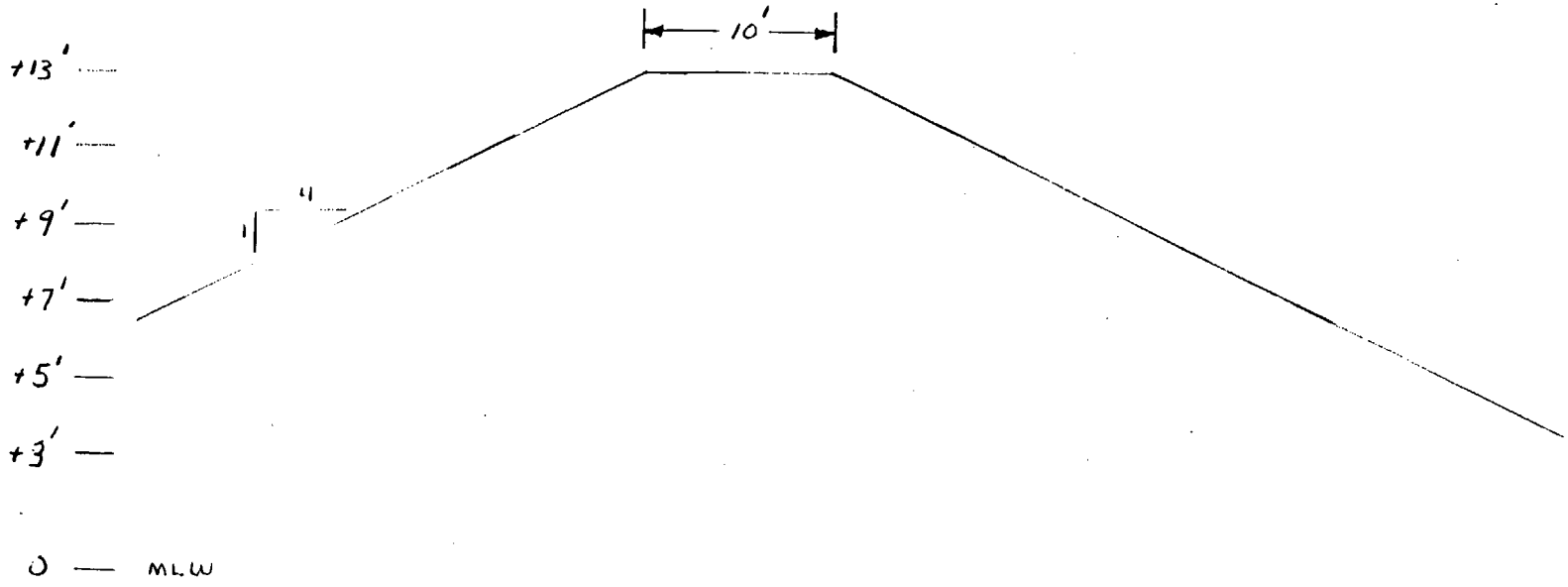


FIGURE 2-6

TYPICAL DIKE SECTION

NTS



LENGTH OF DIKE = 1,890 FEET

STORAGE CAPACITY (GROUND EL. @ 5') = 30,000 CUBIC YARDS

DIKE EL. +13' ALLOWS 2' OF FREEBOARD AND 2' OF PONDING

FIGURE 2-7

APPENDIX 3

PERTINENT CORRESPONDENCE

APPENDIX 3
PERTINENT CORRESPONDENCE
TABLE OF CONTENTS

ITEM

LIST OF STUDY COORDINATION MEETINGS

SECTION A

COPIES OF CORRESPONDENCE AFTER REVIEW OF DRAFT REPORT

SECTION B

COPIES OF CORRESPONDENCE PRIOR TO REVIEW OF DRAFT REPORT

Note: To avoid repetition documentation denoted with an asterisk (*) can be found in the Coordination Letters section of the Environmental Report.

LIST OF STUDY COORDINATION MEETINGS

November 25, 1991 - New England Division (NED) met with town of Chatham's Working Committee to discuss comments on economics analysis.

September 5, 1991 - NED personnel met with town and state representatives to discuss various questions and comments the local sponsor had regarding study assumptions and criteria.

August 12, 1991 - NED personnel met with concerned citizens to obtain additional economic information by releasing another set of questionnaires.

August 1, 1991 - Public meeting held in Chatham to discuss the details of the study's economics and costs.

July 29, 1991 - Representatives of NED and the town met with Congressman Studds to discuss negative findings of the study.

May 20, 1991 - Meeting between sponsors of the study and various resource agencies to discuss plans studied in detail and the environmental impacts expected with each plan.

February 28, 1991 - An Executive Committee (sponsors of the study) meeting was held at the Cape Cod Canal office to discuss study progress to date.

December 19, 1990 - Environmental workshop held in Hingham. Representatives from NED, the town, Fish and Wildlife, MA Dept. of Environmental Protection, and MA Coastal Zone Management met to discuss various plans of improvement.

December 18, 1990 - Economics workshop in Chatham held to distribute economics questionnaires and gather pertinent information.

November 20, 1990 - Public hearing held in Chatham to present the study process. Attendees were given opportunity to ask questions and make formal statements.

November 15, 1990 - Representatives of NED, Fish and Wildlife, and MA CZM met to discuss the navigation study. Impacts to the environment as a result of dredging, disposal, and structural improvements were of particular concern.

October 10, 1990 - Initial coordination meeting between NED, the town of Chatham, and MA DEP to discuss the study funding and schedule.

APPENDIX 3

SECTION A

COPIES OF CORRESPONDENCE
AFTER REVIEW
OF DRAFT DETAILED PROJECT REPORT

APPENDIX 3

SECTION B

COPIES OF CORRESPONDENCE PRIOR TO REVIEW OF DRAFT DETAILED PROJECT REPORT

NED RESPONSES TO

TOWN OF CHATHAM

WORKING COMMITTEE

COMMENTS

Comment 1. Page 1 CT: Paragraph 1: Interest rates are dropping. Is 8-3/4% lowest rate available?

Response: Regulations require the use of 8 3/4 % for Fiscal Year 1991 in the evaluation of water resource projects.

Comment 2. Page 1 CT: P.3, Sentence 1. Why is 1980 quoted year? The figure is ten years old and 1990 is readily available.

P.3, last sentence: In the breakdown of the four leading industries, no mention of the fishing industry is made. By showing zero statistics on fishing, the sentence implies the fishing industry was so small that it was not included in the four leading industries. This statistic gives a negative impression.

No figures would be available for commercial fishing as no one pays unemployment. Taken in this context, the sentence is irrelevant.

The "Draft" needs a credible source of information. Note: the 1978 MIT study of Chatham fisheries has statistics.

Responses: Page one provides background information to support analysis but is not critical to the analysis.

Comment 3. Page 2, CT: P.1, in the last sentence "more" is incorrect. Conditions have not changed. The "new bar" is no worse than the "old bar."

Chatham questions the need to make the bar appear worse than it actually is.

Response: Agreed.

Comment 4. Page 2 CT: P.2, S.1: "nearly is incorrect. Navigation is not possible.

In S.2, "shoaled to one (1) foot at MLW is incorrect. The "one (1)" should read "zero (0)".

Response: Comment may be true, but not relevant to the analysis. Survey by the Corps in January 1991 shows one foot MLW.

Comment 5. Page 2 CT: P.5 is incorrect. Chatham's figures cannot be computed with Provincetown.

Response: National Marine Fisheries (NMFS) include Chatham landings with those of Provincetown to avoid identification of data sources. Separation of data is not critical to the analysis.

Comment 6. Page 3 CT: The figures in T-1 are quoted from what source?

Do the figures include tuna, lobster and shellfish?

The T-1 landings are 2/3 of Barnstable County catch and Chatham does not land underutilized species. Provincetown (not Chatham) lands underutilized species with a resultant lower price per pound.

The two towns must be separated to get a correct landing value.

Response: National Marine Fisheries (NMFS) is the data source for Table 1. Again these data support the analysis, but are not critical to the determination of project benefit.

Comment 7. Page 4 CT: T-2 on pages 4 and 5 is not applicable to Chatham. The 1989 figures less landings with more value per pound.

Response: This Table is provided as background information for the analysis. The separation of Chatham landings from Barnstable County landings is not possible. However, this information is not needed to determine project benefit.

Comment 8. Page 5 CT: Same as page 4.

NOTE: Incorrect addition. The corrected total of pounds should read 35,340,915.

Response: This Table is provided as background information for the analysis. The separation of Chatham landings from Barnstable County landings is not possible. However, this information is not needed to determine project benefit.

Comment 9. Page 6 CT: It is suggested that P.1 and P.2 should be reversed.

In P.2, S.1, delete "other." Stage Harbor is a secondary fishing center. The harbor freezes over in winter.

Response: The order of discussion of Aunt Lydia's Cove and Stage Harbor is not important to the analysis.

Comment 10. Page 6 CT: P.1, S.4: RE: Stage Harbor: There is not off-loading public dock in Stage Harbor. There is a seasonal float. There is no public access to fuel or ice at the Town owned facility. There is no available mooring space in Stage Harbor.

Response: The text has been revised.

Comment 11: Page 6 CT: P.3: The 7,208,375 lbs. shown is the box count of fish. This figure does not include tuna, lobster and shellfish.

(If six lobster boats averaged 18-20,000 lbs., or 100,000 lbs. per year, using the 1988 figure of $3.33 = $333,000.)

National Marine should produce figures on tuna, sea scallops landed 76-81.

The Chatham Shellfish Department has records of shellfish landed, areas fished, etc.

Response: Tuna and Lobster landings were not available for Aunt Lydia's Cove. However, they were available at the county level and are shown in Table 2. The value of overall landings is not critical to the calculation of project benefit.

Comment 12. Page 7 CT: Since the break in North Beach, there are more boats fishing out of Aunt Lydia's Cove with more fish landed.

(Maybe more trips could be taken through the "new" break? As shoaling occurred, there were less trips, less fish.)

Response: The number of fishing trips in both the with project and without project condition is assumed to be the same. It would be difficult to determine the long run impact of increased fishing effort on fishermen's profitability.

Comment 13. Page 7 CT: See Page 6, P. 3

Comment 14. Page 8 CT: P.1, S.2: Note: "Two-thirds of catch" with a higher dollar value per pound. (Tuna would also have higher value per pound.)

Response: The value of overall landings is not critical to the calculation of project benefit.

Comment 15. Page 8 CT: T-4: The total of the boats is 159. How does this tie in with T-3? Question the source of information.

Response: As most boats fish more than one type of gear, the total number of boats in the fleet cannot be obtained by adding the number of boats by gear.

Comment 16. Page 10 CT: Table 6 shows 13 boats drawing 3' or less of water. A boat cannot get out at MLW if there is not 3' of water at the spar channel.

Response: This comment is true.

Comment 17. Page 11 CT: P.1, S.3: The time is incorrect. The corrected average steaming time would be closer to one hour and fifteen minutes.

Response: This information pertains to steaming time before the break. It was provided as background and is not critical to the determination of project benefit. The paragraph has been revised.

Comment 18. Page 11 CT: P.2, S.1: The sentence is erroneous. More fishing hours, days per year would increase "quantity" of fish.

S.2: Erroneous. Missing a truck to NY/Boston changes Quality and price of product.

Response: The effect of an increase of fishing effort on the long run profitability of fishermen is difficult to determine. This study assumes that the number of hours fishing in both the with project and without project condition is the same.

The intent of this paragraph was to show that the fish catch does not change as a result of the project. Thus there should be no change in ex-vessel price. The analysis does recognize that there is a qualitative difference in fish that are not shipped to New York or Boston the same day that they are landed. The analysis considers this loss in fish value.

Comment 19. Page 12 CT: P.2, S.1: Omit "and in the breach." Historically "the Bar" has remained "the Bar."

Response: Information collected from questionnaires indicate delay at the breach during periods of mean low water (MLW).

Comment 20. Page 12 CT: P.3, S.1: What crew number per boat size or any boat size is used for this Study? The A/E December 1989 preliminary study showed crew number size for different boat size. The 1991 A/E Draft Economic Assessment Report does not show this figure. In the 1991 report the only crew size mentioned is on Page 12, P.5, S.7, which uses a crew size of two. Are two crew members used for all boats in the 1991 Economic Assessment Report?

Response: Crew size was determined for each vessel based on information supplied to the Corps. The range was 1 to 4.

Comment 21. Page 12 CT: P.3: What constitutes a trip? (Is a trip going over the shoal area at some point in time, then returning over the shoal area at a later point in time?)

(Or, would a trip constitute a trip each time a boat passes over the shoal area? Would a one-day fishing trip require two trips over the shoal area?)

Response: Trip is defined as a roundtrip to the fishing grounds and back. Delays were calculated as a percentage of return trips to Aunt Lydia's Cove. Only 29 of the 70 vessels in the study moor inside the cove. Of these 29 vessels, those vessels that set static gear, such as gillnets and longlines, were assumed to make two trips to the fishing grounds - the first to set the gear and the second to haul the gear. This group would be susceptible to two possible delays in returning to Aunt Lydia's Cove.

Comment 22. Page 12 CT: P.3: The problem is getting to the Fish Pier. The delay is NOT at the Bar. The tidal delays have to be changed to reflect the pier delays, not the undocumented Bar delays.

When a boat cannot get to the pier and misses that day's truck to market, three important problems arise:

(1) The fish price changes;
(2) The quality of the fish changes;
(3) The next fish day is LOST to the BOAT.

(Even when fish were off-loaded at night in skiffs from the outer cove moorings, fuel could not be purchased. Because of inaccessibility to the pier, fuel could not be put on board until the next day when tidal conditions allowed. So, depending on timing of fuel, that fish day was LOST or delayed.

Response: Tidal delays shown in the report reflect delays at both the spar channel and the breach. Benefits are developed for plans that both include and exclude dredging in the breach. Surveys provided to the Corps show delays in the breach as well as the spar channel.

Project benefit is an estimation of actual physical delays where extra hours of labor and gallons of fuel are expended waiting for adequate depth to transit the spar channel. The analysis does not address additional depth related inefficiencies such as curtailing a fishing trip to avoid tidal delay or as a result of tidal delay, missing a fishing trip the following day. These inefficiencies have an affect on work effort which potentially has an affect on fish catch. However, changes in fish catch as a result of increased effort are difficult to document and even more difficult to obtain concurrence form National Marine Fisheries (NMFS). This report assures fish catch will remain constant with the project.

Comment 23: Page 12 P. 4: In determining tidal delays for a boat, how is maximum delay time computed?

Does it take flooding tide time from MLW to depth needed (calling it average delay time) then double it to derive a maximum delay time?

Response: The boat draft and underkeel clearance are used to determine tidal height required for the boat. Unloaded boat drafts were obtained from the Town. Loaded drafts for each boat were estimated by adding one foot to the unloaded drafts of each boat. Underkeel clearance was assumed to be one-half foot for the spar channel and two and one-half feet for the breach. Boat draft and underkeel clearance determine how much depth a boat needs to transit the channel. The channel depth at MLW combined with the tidal charts is used to determine the probability that the needed depth is not available. Applying this probability to the number of trips determines potential delays for a given vessel.

The extent of a given delay is the average delay which is one-half the maximum delay. Maximum delay is the total time that the vessels required depth is not available from outgoing tide to incoming tide.

The relationship between the maximum delay and the depth needed from MLW was estimated by the Corps by fitting the tidal range to a cosine type curve. With a change in parameters this relationship was tested on a known tidal curve for Boston Harbor and gave a good fit with some small error. A linear tidal curve similar to that demonstrated by the Working Committee in a meeting on November 25, 1991 was initially used by the Corps. The Corps subsequently developed a non linear tidal curve to reduce the estimation error involved in determining maximum waiting time for a given required depth.

Since some potential delays can be avoided by planning, not all potential delays are actually experienced. In the pre-draft Economics Appendix, it was assumed that one-half of potential delays could be avoided. For a without project spar channel depth of three feet MLW, this assumption seemed reasonable. However, for a depth of one foot MLW, avoidance of one-half of potential delays did not seem reasonable with a tidal range of less than five feet. In the draft Economics Appendix the proportion of delays avoided for a given vessel is inversely related to the depth that a vessel needs for a given channel depth.

Comment 24: Page 12 P. 4 & 5: Question the assumptions behind calculation of loss due to tidal delays.

Response: See Response to Comment 23.

Comment 25: Page 13 P. 4, S3: How was the draft computed for a given boat?

Response: Vessel draft information was obtained from the town and from fishermen through the questionnaires. Loaded drafts were estimated by adding one foot to unloaded drafts.

Comment 26: Page 26 P. 4, Sec. 4: Question: Why was information provided by a dealer? The fishermen filled out questionnaires provided by the Army Corps of Engineers (see S-9), and the 28 questionnaires reported a total of 4,125 trips, or an average of 147 trips.

Why did the Army Corps of Engineers choose to disregard this information and ask one dealer to supply information already supplied by fishermen?

NOTE: Although 147 trips were averaged by 28 questionnaires, this is not a true figure. Many Chatham boats stay 48 hours but would be counted by a dealer as only one trip.

Response: The questionnaires were supplemented with additional data as only 28 of the 70 vessels in the fleet responded to the questionnaire. Information on the questionnaires was not disregarded but used along with other data to acquire a better understanding of fishing fleet operations.

Comment 27: Page 13 P.4, Sec. 5: What does this sentence mean: Who "adjusted" what? Fish landed over the South Jog could mean "no dealer".

Response: The total number of trips that the fleet made was based on dealer information. There is no dealer information for landings at the south jog. Thus the dealer based number needed to be increased to obtain a more accurate estimate of fleet trips.

Comment 28: Page 13 P.4, Sec. 10: Ref: ARMY CORPS 1990 CHATHAM ECONOMIC ASSESSMENT REPORT: "For 1989 (NMFS) reported a total of 6,056 trips for all Chatham fishermen excluding trap fishermen that work out of Stage Harbor."

Ref: Page 2, Page 4, Sec. 2: Reference: ARMY CORPS 1990 CHATHAM ECONOMIC ASSESSMENT REPORT: "NMFS report that in 1989 these vessels (246) made 7,416 trips." Question numbers.

Response: The major difference between the two numbers represent trips by trap fishermen.

Comment 29: Page 14 P.1: In addition to delays experienced by vessels in Aunt Lydia's Cove, also need to add operating costs and delays for those boats temporarily relocating to Stage Harbor or other ports.

Response: Agreed. The latest revision has included additional operating cost for vessels expected to relocate to Stage Harbor in the without project condition.

Comment 30: Page 14 P.2, Sec. 1: eliminate "and the breach".

Response: The Corps does not agree that the potential for delay does not exist in the breach. Some questionnaires received from fishermen support this position, conversations with fishermen and conversations with the Coast Guard support this position.

Comment 31: Page 14 Table 7: Other items that should be included are wheels, haul-outs, labor haul-out, loss of fishing time at haul-outs, crew time @ 11.50/hour.

Estimate 2-3 days of down-time only if marinas are readily available to accept vessel at a moment's notice. The figure must be adjusted to reflect the above.

Some estimate of the probable cost of more serious vessel damage should be added to Table 7.

This problem to this extent would not exist if Aunt Lydia's Cove and channel were dredged and maintained.

Response: Damages are based on information provided by fishermen in the questionnaires. The information in Table 7 is meant to be illustrative of the type and cost of items damaged.

Comment 32: Page 15 P.2, Sec. 4: If assuming one buyer, why assume 25% of value? Where was the local information obtained? Please document.

Response: The analysis does not assume one buyer. Twenty-five percent reduction in value based upon information supplied by fishermen.

Comment 33: Page 15 P.2, Sec. 5: NOTE: One(1) foot of water at the spar channel would affect all boats. All boats would encounter the loss - not the 41' - 50' boats as reported by A/E.

Response: Agreed. The revised economic analysis reflects potential reduction in value to all boats as a result in the change in without project spar channel depth to one foot MLW from three feet MLW.

Comment 34: Page 15 P.2, Sec. 6: Due to 1' water at, decrease/increase larger dollar value than 5%.

Response: Agreed. In the revised analysis the loss in fish value increased.

Comment 35: Page 15 P.3, Sec. 1: Obviously Ohio and Florida and California buy day old fresh fish. The uniqueness of good quality, Chatham fish is trucked by customer choice to Ohio and Florida, rather than air freight. Because of good quality, fish can stand the longer trip.

Comment 36: Page 15 P.5: Does not pertain to anything unless the A/E would consider placing into the record Chatham landing figures for other species such as scallops during the 1970's (as alluded to in Page 5).

MIT 1978 Page 47: 1977 sea scallops landing 736,000 lbs. @ $1,619,000. It was noted this was the sea scallop declining years and the previous years were at least as much if not more.

Response: The information in this paragraph is required by regulations (ER 1105-2-100, Chapter 6, Section IX) and supports the analysis of habitat condition for major fish species harvested at Aunt Lydia's Cove.

Comment 37: Page 16: Strike Page 16: Not applicable to report.

Response: The information on this page describes habitat condition and is required by regulations (ER 1105-2-100, Chapter 6, Section IX)

Comment 38: Page 17: Table 9: Other repairs not factored in: electric, cap logs, beam, bulkhead, undermining and probability of catastrophic loss.

At what borrowing rate do these figures compound to arrive at cost for each year?

Response: Information in this table was provided by the Town of Chatham. Costs discounted and annualized at the interest rate of 8 3/4 % as required by regulation.

Comment 39: Page 18: P.1, Sec. 3: Question controlling depth of minus one (1) foot at MLW.

Page 1, Sec. 5: Strike this sentence. The figure of $125,000 included more than the spar channel and Aunt Lydia's Basin.

The Town has dredged the spar channel for $80,000 and $165,000 for spar channel and basin.

There is no way of determining Town continuation for the upkeep of this area.

Response: A controlling depth of -1 MLW was the result of a Corps survey in January 1991. The without project condition has changed in the latest revision to reflect no local dredging in the absence of a federal project as stated in the 12 August 1991 letter from the Town of Chatham, Office of Selectmen.

Comment 40: Page 18: Table 10: Question if Page 14 shows impellers for fishing boats at $200 and the USCG has 4, shouldn't this figure reflect $400?
The table does not reflect haul-out costs, group spare costs.

Response: Information used was that supplied to the Corps by the Coast Guard and fishermen.

Comment 41: Page 21: P.1, Sec. 2: No damage by breach.

Response: Damages in the breach are not discussed on this page.

Comment 42: Page 21: Table 12: Change spar channel to read "at (0) zero feet MLW".
Under delay - question the amount allotted to labor costs.
Under Fish Value - there is fish value due to delay time not reported.
Question all figures in this Table.

Response: Information in Table 12 has changed to reflect without project condition of minus one foot at MLW.

Comment 43: Page 22: (Also Re: A/E Economic Assessment Report, page 12, P.2-5) which method is standard A/E practice of determining tidal range using two different methods to compute ratio; (1) average tidal range, (2) actual Chatham tidal cycle?
Why does the A/E give different figures?

Response: Determination of tidal range makes use of the actual Chatham tidal cycle as estimated by the Corps. There is no inconsistency between pages 12 and 22. Shoaling rates are discussed on Page 22 and on Page 12 tidal delays are calculated based on channel depths which are affected by shoaling rates.

Comment 44: Page 22: P.1, S.9: Estimate should be given to serious catastrophic medical injury or permanent disability.

Response: Accidents resulting in personal injury are difficult to predict. The consequences of these accidents, including fatalities, are difficult to quantify. Cost benefit analysis does not usually assign a value to human life.

Comment 45: Page 22: P.3, S.1: Delete "not" and leave in "is anticipated," etc.

Response: It is difficult to quantify increased fish catch as a result of reduced tidal delay. Thus the analysis assumes that fish catch does not change with the project.

Comment 46: Page 23: P.2, S.2: Delete sentence two. The Army Corps of Engineers cannot assume the Town of Chatham or the State of Massachusetts will continue to dredge as has been done in the recent past years.

Response: Agreed. The without project condition has been changed to reflect the absence of local dredging.

Comment 47: Page 23: Table 13: (See Page 17). Same question requesting information.

Response: Information in this table was provided by the Town of Chatham. Costs discounted and annualized at the interest rate of 8 3/4 % as required by regulation.

Comment 48: Page 23: P.4: Without dredged channel, USCG would be unable to immediately respond to life threatening situations in the three town complex of Pleasent Bay.

The A/E report should reflect actual figures for recreational boaters that access Pleasant Bay from Chatham, Harwich and Orleans. The USCG responds to more than 69 f/v in Chatham and those f/v offshore Chatham.

Response: In both the with and without project condition it is assumed that the Coast Guard will perform its mission. This section addresses a reduction in the cost to perform this service. It was not felt necessary to develop background information on the total fleet serviced by the Coast Guard.

Comment 49: Page 24: Pages A/E 24, 25, 26; Chatham Working Committee requests that these pages be put on hold until discussion on changes are presented to the Department of the Army Corps of Engineers by this Committee.

Response: These pages refer to delays in the breach. The Chatham Working Committee has since met with the Corps.

Comment 50: Pages 26 - 36; Also Plans B-1, B-2, B-3, B-4 show projected costs dramatically higher than ones already incurred by the Town of Chatham. Please explain.

Comment 51: Page 28: Table 17 Correct line (1) to 313,400, Line (2) to 193,700. Lost fish value should reflect the correct true percentage of loss.

Response: Table has been revised.

Comment 52: Page 33, Table 21: Correct 8' benefit-cost ratio is 0.3.

Response: Table has been revised.

Comment 53: Page 34 Table 22; Correct net benefit change to 242,300. Would Town of Chatham 96,300 be the variable?

Response: Table has been revised.

Comment 54: Page 36, Table 25; Correct annual net benefit to 140,200.

Response: Table has been revised.

Comment 55: Page 38, Table 27: Line (2) corrections 334,700 and 409,600.

Response: Table has been revised.

Comment 56: Page 39; Table 28; Please explain "0" under catch value.

Response: Table has been revised.

Comment 57: Page 40 Table 30; Correct under 4' to 0.3 and 6' to 0.6 (see page 33).

Response: Table has been revised.

Comment 58: Page 45, Table 35; Correct 8' to 1.0.

Response: Table has been revised.

Comment 59: Page 45; Table 36; Correct 4' to 0.4.

Response: Table has been revised.

General Question: Why were there so many discrepancies between the 1989 draft and the 1991 draft in the Economic Analysis Navigational Section?

Response: The current draft economic analysis uses more refined data than the 1989 draft. The current analysis reflects the effects of breach depth on navigation of Aunt Lydia's Cove. In the 1989 report the breach was deeper and not seen as affecting the navigation of Aunt Lydia's Cove for larger boats. As the vessels require tidal assistance to cross the breach, they are also now entering the Cove at higher tidal stages there by reducing the amount of potential delay in the Cove.

Chatham Harbormaster

613 Stage Harbor Road
Chatham, Mass. 02633
Telephone (508) 945-9696

October 23, 1991

Colonel Philip Harris
Department of the Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Harris;

The Town of Chatham's Working Committee has discussed and reviewed in detail the findings of the 1991 Economic Assessment of Chatham Harbor as prepared by the Department of the Army Corps of Engineers.

This Committee submits to you and the Department of the Army Engineers, the following enclosed statements and questions (eight pages) for your review and response.

The Committee has valid points of contention that we wish to discuss with you and your staff.

James Lindstrom, Executive Secretary, Chatham, will be telephoning you and your representatives shortly to set up a working session with this Committee. The Committee holds November 4, 6 or 7, at 4:00 P.M. or later as open dates for a scheduled meeting.

Thank you for your consideration.

Peter B. Ford

Peter B. Ford, Chairman

Committee Members: Chris Davis, Mike Ryder, Donna and Doug Matteson, Sandy and Jack Koski, Jack Our, John Our, David Carnes, Stuart Moore, Kassie Abreu, Stuart Smith, Shareen and Ernie Eldredge, Nick Brown, Stuart Tolley, Jim Lindstrom and Andy Young.

xc: Representative Gerry Studds
Chatham Board of Selectmen
John Smith, Army Corps of Engineers
Chris Hatfield, Army Corps of Engineers
Aunt Lydia's Cove Committee

TOWN OF CHATHAM WORKING COMMITTEE
10/23/91 REVIEW OF 1991
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS
ECONOMIC ASSESSMENT OF CHATHAM HARBOR

FEASIBILITY STUDY
(DRAFT)

Reference:

Page # refers to A/E Feasibility Report
CHATHAM refers to Chatham Working Committee
P. refers to Paragraph
S. refers to Sentence

TOWN OF CHATHAM WORKING COMMITTEE
10/23/91 Review of 1991 Department of the Army Corps of Engineers
Economic Assessment of Chatham Harbor

Page 1 CHATHAM: Paragraph 1: Interest rates are dropping. Is 8-3/4% lowest rate available?

Page 1 CHATHAM: P.3, Sentence 1. Why is 1980 quoted year? The figure is ten years old and 1990 is readily available.

P.3, last sentence: In the breakdown of the four leading industries, no mention of the fishing industry is made. By showing zero statistics on fishing, the sentence implies the fishing industry was so small that it was not included in the four leading industries. This statistic gives a negative impression.

No figures would be available for commercial fishing as no one pays unemployment. Taken in this context, the sentence is irrelevant.

The "Draft" needs a credible source of information. Note: The 1978 MIT study of the Chatham fisheries has statistics.

Page 2 CHATHAM: P.1, in the last sentence "more" is incorrect. Conditions have not changed. The "new bar" is no worse than the "old bar."

Chatham questions the need to make the bar appear worse than it actually is.

Page 2 CHATHAM: P.2, S.1: "nearly" is incorrect. Navigation is not possible.

In S.2, "shoaled to one (1) foot at MLW is incorrect. The "one (1)" should read "zero (0)".

Page 2 CHATHAM: P.5 is incorrect. Chatham's figures cannot be computed with Provincetown.

Page 3 CHATHAM: The figures in T-1 are quoted from what source?

Do the figures include tuna, lobster and shellfish?

The T-1 landings are 2/3 of Barnstable County catch and Chatham does not land underutilized species. Provincetown (not Chatham) lands underutilized species with a resultant lower price per pound.

The two towns must be separated to get a correct landing value.

Page 4 CHATHAM: T-2 on pages 4 and 5 is not applicable to Chatham. The 1989 figures less landings with more value per pound.

Page 5 CHATHAM: Same as page 4.

NOTE: Incorrect addition. The corrected total of pounds should read $35,340,915.

Page 6 CHATHAM: It is suggested that P.1 and P.2 should be reversed.

In P.2, S.1, delete "other." Stage Harbor is a secondary fishing center. The harbor freezes over in winter.

Page 6 CHATHAM: P.1, S.4: RE: Stage Harbor: There is no off-loading public dock in Stage Harbor. There is a seasonal float. There is no public access to fuel or ice at the Town-owned facility. There is no available mooring space in Stage Harbor.

Page 6 CHATHAM: P.3: The 7,208,375 lbs. shown is the box count of fish. This figure does not include tuna, lobster and shellfish.

(If six lobster boats averaged 18-20,000 lbs., or 100,000 lbs. per year, using the 1988 figure of $3.33 = $333,000.)

National Marine should produce figures on tuna, sea scallops landed, 76-81.

The Chatham Shellfish Department has records of shellfish landed, areas fished, etc.

Page 7 CHATHAM: Since the break in North Beach, there are more boats fishing out of Aunt Lydia's Cove with more fish landed.

(Maybe more trips could be taken through the "new" break? As shoaling occurred, there were less trips, less fish.)

Page 7 CHATHAM: See Page 6, P.3

Page 8 CHATHAM: P.1, S.2: Note: "Two-thirds of catch" with a higher dollar value per pound. (Tuna would also have higher value per pound.)

Page 8 CHATHAM: T-4: The total of the boats is 159. How does this tie in with T-3? Question the source of information.

Page 10 CHATHAM: Table 6 shows 13 boats drawing 3' or less of water. A boat cannot get out at MLW if there is not 3' of water at the spar channel.

Page 11 CHATHAM: P.1, S.3: The time is incorrect. The corrected average steaming time would be closer to one hour and fifteen minutes.

Page 11 CHATHAM: P.2, S.1: The sentence is erroneous. More fishing hours, days per year would increase "quantity" of fish.

S.2: Erroneous. Missing a truck to NY/Boston changes Quality and price of product.

Page 12 CHATHAM: P.2, S.1: Omit "and in the breach." Historically "the Bar" has remained "the Bar."

Page 12 CHATHAM: P.3, S.1: What crew number per boat size or any boat size is used for this Study? The A/E December 1989 preliminary study showed crew number size for different boat size. The 1991 A/E Draft Economic Assessment Report does not show this figure. In the 1991 report the only crew size mentioned is on Page 12, P.5, S.7, which uses a crew size of two. Are two crew members used for all boats in the 1991 Economic Assessment Report?

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(Or, would a trip constitute a trip each time a boat passes over the shoal area? Would a one-day fishing trip require two trips over the shoal area?)

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When a boat cannot get to the pier and misses that day's truck to market, three important problems arise:

(1) The fish price changes;
(2) The quality of the fish changes;
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(Even when fish were off-loaded at night in skiffs from the outer cove moorings, fuel could not be purchased. Because of inaccessability to the pier, fuel could not be put on board until the next day when tidal conditions allowed. So, depending on timing of fuel, that fish day was LOST or delayed.

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Some estimate of the probable cost of more serious vessel damage should be added to Table 7.

This problem to this extent would not exist if Aunt Lydia's Cove and channel were dredged and maintained.

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Under Fish Value - there is fish value due to delay time not reported.

Question all figures in this Table.

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Why does the A/E give different figures?

Page 22 CHATHAM: P.1, S.9: Estimate should be given to serious catastrophic medical injury or permanent disability.

Page 22 CHATHAM: P.3, S.1: Delete "not" and leave in "is anticipated," etc.

Having a completed project will increase the number of fish days for the year and will increase fish catch for the port.

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The A/E report should reflect actual figures for recreational boaters that access Pleasant Bay from Chatham, Harwich and Orleans. The USCG responds to more than 69 f/v in Chatham and those f/v off-shore Chatham.

Page 24 CHATHAM: Pages A/E 24,25,26: Chatham Working Committee requests that these page be put on hold until discussion on changes are presented to the Department of Army Corps of Engineers by this Committee.

No data breakdown on costs have as yet been given the Town by the Army Engineers.

Pages 26 - 36 CHATHAM: Also Plans B-1, B-2, B-3, B-4 show projected costs dramatically higher than ones already incurred by the Town of Chatham. Please explain.

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General Question: Why were there so many discrepancies between the 1989 draft and the 1991 draft in the Economic Analysis Navigational Section?

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

September 24, 1991

Mr. Joseph L. Ignazio, Chief
Planning Division
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

This responds to your letter requesting comments on the Army Corps of Engineers' Navigation Improvement Study (107) for Aunt Lydia's Cove in Chatham, Massachusetts.

The following comments and recommendations are a preliminary response to the three proposed alternatives. Plan A is to dredge a 6-foot channel south of Tern Island and maintain the Aunt Lydia's Cove Anchorage. Plan B proposes to dredge a 6-foot channel around the north end of Tern Island and to maintain the Aunt Lydia's Cove Anchorage. And alternative plan C would dredge a 6-foot channel south of Tern Island, maintain the Aunt Lydia's Cove Anchorage, and construct a 900-foot rubblemound jetty just south of the anchorage.

All three alternatives call for dredging of between 20,000 to 40,000 cubic yards of sand to maintain the channel. The disposal would be at Tern Island. Because of the the need to dredge the channel constantly, the establishment of invertebrates and shore birds would become very unlikely because of the continuous pumping of sand on the Island's beach and sandflats. Another alternative to consider would be beach nourishment at nearby beaches such as Lighthouse Beach or North Beach.

Alternative C would construct a rubblemound jetty. We would need more information on this proposal before making a technical evaluation.

In a previous letter regarding the breaching issues affecting the entire Chatham barrier beach system, we recommended that the area be left alone. We further suggested that the COE ask its Waterways Experiment Station to investigate the hydrology and sediment transport characteristics of each of the alternatives. We believe that natural sediment transport will cause the area to fill in. This is based on the technical publication of Woods Hole Oceanographic Institution entitled, "Development, Characteristics and Effects of the New Chatham Harbor Inlet" by G. S. Giese, D. G. Aubrey and J. T. Liu. Based on the valuable commerical and research shellfish resources, along with numerous marine fish which use the area during critical life stages, we recommend that your

agency consider other less disruptive alternatives.

One suggestion that warrants further investigation is that made by the National Marine Fisheries Service to consider the transfer of the fishing fleet to Stage Harbor in Chatham. Finally, there needs to be a Section 7 consultation under the Endangered Species Act for turtles including the Kemp's Ridley turtle (Lepidochelys kempi), the Leatherback turtle (Dermochelys coriacea), the green sea turtle (Chelonia mydas) and the Loggerhead turtle (Caretta catretta).

We appreciate the opportunity to comment on this project proposal. Please keep us advised of the progress of this project. For further coordination, please contact Melvin P. Holmes of my staff at 617 565-4433.

Sincerely,

Edward L Reiner Acting for

Douglas A. Thompson, Chief
Wetland Protection Section

cc: NMFS, Gloucester, MA
F&WS, Concord, NH
MA DEP Wetlands, Woburn, MA
MA DWPC, Boston, MA

TOWN OF CHATHAM

Office of the Selectmen

August 12, 1991

Colonel Philip R. Harris, Division Engineer
Corps of Engineers
New England Division
Department of the Army
424 Trapelo Road
Waltham, MA 02254-9149

Re: Aunt Lydia's Cove, Chatham — Feasibility Study

Dear Colonel Harris:

Our discussions with the study team have been valuable to our understanding of the progress to date. By the time we were done, each of the contract partners had a list of issues to be explored further. Among them:

- Was the January bathymetry an accurate reflection of bar controlling depth at the time and how has it changed since? Anecdotal evidence indicates vessel delays and damage then and now (immediately prior to the Town dredging) were exclusively due to the spar channel depths and rough weather.

- We focused particularly on a statement from your letter :"Past experience indicates that it is unlikely that a controlling depth greater than 6 feet at MLW will again be available."
  The assumption of 6 feet MLW or less as a controlling depth over the bar for the analytical period of fifty years is farfetched. The database to which the study team refers appears to have been built up in reference to the old inlet complex (South Channel) during the last 30 years. Further, it has been coupled with the assumption that the new inlet will conform to the old one within the analytical period. The past may be prologue only if you examine the correct past, which this study has not done.
  In addition, the CERC component of the General Investigation report indicates in strong terms the dynamism of the new inlet conditions, but nowhere indicates or predicts navigation problems over the bar. That conclusion is borne out today by regular observations of shifting channel locations and depths over the bar by the Coast Guard and commercial vessels, who continue to transit the bar at all tides and times of the day with no difficulty with regard to controlling depth.
  We strongly urge you to re-examine this assumption..

- A key assumption is the without-project average depth of the spar channel (3' MLW.) This assumption appears to be based on the expectation that the Town will continue *in extremis* dredging over the 50-year analytical period. In fact, the average is most likely to be ≤1' MLW. (In March 1991, roughly 18 months after the last Town hydraulic dredging, I walked across the

549 Main Street, Chatham, Massachusetts 02633 Telephone (617) 945-2100

spar channel at low tide in a pair of knee boots.) CENED soundings from January clearly show <2' MLW in the same area. The without-project condition within 5 years would probably be a tidal flat exposed at MLW.

On the issue of continued Town dredging, we believe that it is highly unlikely. Beginning in March 1987, it became clear to us that dealing with the long term effects of the new breachway would outstrip local resources. That's what got this series of studies rolling in the first place. We have seen no evidence to change that conclusion.The $525,000 raised by the Town for dredging will have a balance left of about $125,000 by the end of the most recent project. The entire amount was approved by the voters with the explicit understanding that it would be used to tide us over until the feasibility study was completed, and to provide for a significant portion — perhaps all — of the non-federal cost share. Town meeting debate was materially swayed by these factors. (For the Town to dredge on its own even required special state legislation to permit a bond issue for dredging.)

Chatham is being severely impacted by Proposition 2½. Our success rate on override elections has tumbled dramatically and is likely to stay that way for quite some time. Enclosed is a copy of the most recent five-year projections for the Town's budget. You will find them illustrative of our point.

We conclude there is a high probability that the Town would be willing and able to share in the cost of a project.

We conclude the probability of continued Town dredging without a federal project, contrary to that assumed in the study, approaches zero within five years.

- The linkage between the bar depth and the "complete project" requirement is also debatable in view of current and future commercial use of the Cove and the assumptions used in without-project assessment. Not addressed in the current study are commercial uses unconstrained by the bar — ie. vessels engaged in commercial fishing and shellfishing ***within*** the Pleasant Bay estuary. Shellfish (particularly blue mussel) landings in the Harbor have increased dramatically in the last year, after recovering from the sedimentation problems immediately following the 1987 breach. Year-round volume catch handling and transshipment issues are vital considerations and are available only at the Cove. Mussel, clam, quahog and lobster boats use the Cove, many of which offload on the beach by the North Jog without requiring a pier permit.

  The current study does not appear to capture any of this activity.

- The issue of completeness and timing of the survey questionnaire was raised and will be addressed by a new survey now under way. A subset of this issue is proper accounting for the high value fisheries not included in the Town Wharfinger's box counts — particularly tuna, lobster and all shellfish.

- Cost analyses for dredging, spoil disposal and construction presumably include some variability, which are not indicated in the report we have received so far. Is the analysis based on median values derived from how large a range? Dredge spoil disposal analysis includes substantial annual costs for emptying and transporting spoil from the CDF to some other location away from Tern Island after the first 18 months or so. In our view, dewatering in the CDF and mechanical redistribution to renourish Tern Island would reduce costs substantially and serve the need to retain Tern Island as a surge barrier for the north end of the Cove.

- We understand there is some debate over the accounting for labor rates in calculating delay times, among other things. We are encouraged at the opportunity cost approach used in the

analysis and urge that it be strongly defended as the best approximation of reality. "Employee" mobility out of the commercial fleet exists, and for the reasons cited.

- There is a question whether without-project analysis captures full national costs for relocation or dispersal of the fleet. Granting that ***current*** boat investment and shoreside facilities costs are considered sunk, to what extent do you account for the incremental costs of equivalent investment in the other harbors to which the fleet may have to relocate? Chatham has a mostly day boat fleet and obtains a market premium for its products as a consequence. Infrastructure improvements to directly support a relocated fleet would be a new addition to harvesting cost, avoidable with a Cove project, above and beyond the additional costs cited for increased steaming time, etc. Relocation to a harbor supporting trip boats, like New Bedford, may avoid the new infrastructure problem, but at the loss of value of a day boat fleet.

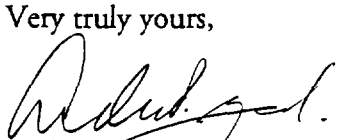
  An equivalent question has arisen regarding indirect support activities. The capital investment of ***current*** net strippers, baiters, gear fabricators, fuel dealers, fish brokers, transport companies and fish processors is a sunk cost. The new capital investment to re-create similar services elsewhere — without which the fleet can not operate — appears to qualify as a new addition to harvesting cost, as well.

- There continues to be a question regarding the exclusion of "secondary" benefits. They are of immense importance in this town and are amply documented. Consequently, we ask you to re-examine this issue after consulting the following credible source: ***Use of Economic-Environmental Input-Output Analysis for Coastal Planning, with Illustration for the Cape Cod Region***; Dennis King and David Storey; Water Resources Research Center, University of Massachusetts, Amherst, MA; Office of Water Resources Research, Department of the Interior; 1974.

- At this stage of the discussion many of the issues revolve around CENED policies and regulations controlling preparation of feasibility studies and findings necessary for a federal project. Consequently, we request copies of those policies and regulations to further our understanding.

This is not an exhaustive list of the issues raised at the meeting, but those that appear to have serious quantifiable consequences for the feasibility study. We urge you to view them as constructive comments and questions for urgent consideration by CENED.

Very truly yours,



Andrew P. Young
Vice Chairman

cc: Mark Forest
Lesley Lewis

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

July 29, 1991

Honorable Gerry E. Studds
United States House of Representatives
Washington, DC 20510

Dear Representative Studds:

In response to a request by Mark Forest of your staff, I offer the following comments on the Corps of Engineers letter, dated July 19, 1991, updating you on the Aunt Lydia's Cove Feasibility Study.

The Corps has stated that "dredging the breachway would be inconsistent with both the COBRA and the Massachusetts Coastal Zone Management Plan"(sic). First, the barrier beach, known locally as North Beach, is not currently part of the CBRA system. Since it is within the Cape Cod National Seashore, it is considered an "otherwise protected" barrier. The CBRA, as reauthorized in 1990, does have provisions to include these lands on a site specific basis, and the National Seashore will be encouraged to apply for inclusion into CBRA within the next eighteen months.

Regarding consistency with the Massachusetts Coastal Zone Management Plan, the Corps has not requested this Office to begin a federal consistency review. Therefore, there has been no consistency decision rendered by this Office. We have however, recently commented on the three proposed construction alternatives in a letter dated June 25, 1991 (attached). As you can see from that letter, the discussion is based on dredging and disposal alternatives within Aunt Lydia's Cove, and makes no reference on dredging through the breach.

I hope this clarifies MCZM's position on the Study. We have not yet received the draft study and therefore can not comment further on the analysis the Corps has provided regarding these issues. If we can be of any further assistance, please contact myself at (617) 727-9530, or Pam Rubinoff, the Regional Coordinator at (508) 362-3828.

Sincerely,

Jeffrey Benoit
Director

cc:
Colonel Harris, COE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

July 19, 1991

Planning Directorate
Plan Formulation Division

Honorable Gerry E. Studds
Representative in Congress
247 Post Office Bldg.
New Bedford, MA 02740

Dear Mr. Studds:

I am writing to update you on the Aunt Lydia's Cove, Chatham, Feasibility Study. The study is essentially complete and the final report will be available for public review in September.

It is becoming apparent that there are no economically viable solutions to the commercial navigation problem in the Cove. The Corps of Engineers cannot participate in any solution that does not meet certain criteria for Federal assistance, including economic viability.

A year ago it appeared that shoaling in and adjacent to the Cove presented the only problem. Over the past year the controlling depth of the natural channel through the Nauset Beach breachway has decreased from over 10 feet below mean low water to its current depth of about 6 feet. The 6 foot depth for those exposed conditions is not sufficient to provide safe passage for the fishing vessels. The result is that we have now included a delay (waiting period) that vessels would encounter during low tide periods, even after project implementation. That delay causes a substantial reduction of project benefits. Additionally safe passage of vessels to and from the open ocean becomes a question.

Consideration was given to continuing the Federal Channel through the breachway, but the cost of this additional work brought the Benefit to Cost (B/C) ratio well below unity. As you know, a B/C ratio of greater than 1 is a requirement of Federal involvement. Also, please be aware that the barrier beach is part of the Cape Cod National Seashore and is protected under The National Coastal Barrier Resources Act (COBRA). Dredging the breachway would be inconsistent with both COBRA and the Massachusetts Coastal Zone Management Plan.

It is apparent the breachway will not close in the foreseeable future. The large Pleasant Bay estuary will continue to flush through the breachway on the changing tides. What is not clear is the controlling depth that can be expected as the system continues to stabilize. It may remain at 6 feet, but could decrease. Past experience indicates that it is unlikely that a controlling depth greater than 6 feet at MLW will again be available. Therefore, as in the past, navigation through the inlet will be unsafe and dependent on the tides.

I felt that you should be notified immediately of this turn of events. I will send a similar letter to the Town of Chatham and the Massachusetts Department of Environmental Management.

If you wish to discuss this matter further, I can be reached on (617) 647-8220.

Sincerely,

Philip R. Harris
Colonel, Corps of Engineers
Division Engineer

Copy Furnished:

Honorable Gerry E. Studds
House of Representatives
Washington, DC 20515-2110

TOWN OF CHATHAM

Office of the Selectmen

March 27, 1991

Mr. Joseph L. Ignazio
Director of Planning
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio,

The Board of Selectmen has reviewed your letter of February 11 regarding alternatives for the feasibility study of Aunt Lydia's Cove (ALC) now under way. Our comments refer to each alternative number where applicable.

1) Heavy winter icing, relative lack of shoreside facilities and parking, and substantial additional steaming time to the usual fishing grounds make Stage Harbor a poor alternative to ALC. We understand this is a component of "without project" analysis and believe that is its proper place.

2) This is the original intent, including as-needed dredging where natural channels are blocked, up to but not including the main ebb tide delta (most seaward). Chatham has always had an inlet bar, and the failure or tremendous cost of stabilizing inlets elsewhere to eliminate the bar problem suggests it is not worth trying here. Our main problem lies from the bar landward into ALC. Chatham Harbor appears to form natural channels readily, with occasional humps and dead ends. Those obstacles, the entrance to ALC, and the turning and mooring basin within ALC are the main focus we suggested.

549 Main Street, Chatham, Massachusetts 02633 (508) 945-2100

3) This alternative is very attractive. In conjunction with the dike in 4), it would appear to shelter ALC from surge, reduce shoaling within ALC from current flow, and provide a stable entrance channel for most of its length. We have two concerns with this approach, however. From observation of the existing spar channel, it is likely the north channel would be difficult to stabilize as it turns perpendicular to the main harbor's north/south current flow. Construction cost, through extensive flats west and north of Tern Island, also appears sizeable. We have received negative and positive comments on this idea, which we have forwarded to you.

4) Failing 3), some provision for surge protection is badly needed. If that device can also alleviate shoaling of a new channel south of Tern Island, all the better. It may be possible to accomplish the same effects of 3) at a lesser construction and maintenance cost, and in an environmentally acceptable manner.

5) & 6) are subject to the comments above.

With the exception of the North Beach alternatives, all of the disposal sites mentioned are reasonable. Due to the cost of pumping sand and the need to stabilize or even augment Tern Island, sites nearest the dredging appear to make the most sense. If dredging occurs further south, as suggested in 2), renourishment of eroding public beaches nearby would be a priority.

As a general matter, the issue of environmental acceptability in Chatham Harbor is as dynamic as its physical features. Over the expected evolution of this new inlet, we are likely to see the area of this concern, Aunt Lydia's Cove, become more stable - perhaps in thirty years or so. In the meantime, we and, we hope, the Corps of Engineers can help maintain a viable commercial fleet in this location.

Very truly yours,

Andrew P. Young
Chairman

APY/eka

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Management

349 Lincoln Street
Bldg. #45
Hingham
Massachusetts
02043
(617) 740-1600
Fax: 727-2950

Bureau of
Coastal Engineering

March 1, 1991

Colonel Philip R. Harris
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Re: Federal Feasibility Study
Aunt Lydia's Cove
CHATHAM

Dear Colonel Harris:

We have been informed of the possibility of discontinuation of the Section 107 Continuing Authorities Program, and the further possibility of cancellation of the feasibility study for dredging at Aunt Lydia's Cove, Chatham. We respectfully request that work on this feasibility study be continued to completion, since state and local funding for the study are already in place.

The issues being addressed by the study are of critical concern to both the community and the Commonwealth, since the area affected represents a major regional source of economic activity and serves fishing boats from Chatham and the nearby towns of Orleans, Brewster and Harwich. Completion of the feasibility study will, at the very least, provide necessary information for pursuit of other funding sources, if the Section 107 program is not restored.

Please feel free to call me if you have any questions, or if further action is required on our part in order to continue the study. I can be reached at (617) 740-1600.

Very truly yours,

Eugene F. Cavanaugh
Director and Chief Engineer

LRL/mel

TOWN OF CHATHAM

Office of the Selectmen

February 28, 1991

Colonel Philip Harris
US Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Re: Aunt Lydia's Cove -Feasibility Study

Dear Colonel Harris,

We enjoyed meeting with you last February 11 with representative Studds to discuss the funding of the proposed dredging project for Aunt Lydia's Cove. We met today with the Executive Committee to discuss the project further. We wish to express our continued desire to complete the feasibility study. Ensuring a stable guaranteed access to the Fish Pier is of vital importance to the livelihood of many Chatham residents. We look forward to working with you in completing this important project for the Town.

Very truly yours,

Andrew P. Young, Jr.
Chairman

JAL/cm

cc: Eugene Cavanaugh, Division of Waterways

549 Main Street. Chatham. Massachusetts 02633 (508) 945-2100

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF
Planning Directorate
Impact Analysis Division

Mr. Philip G. Coates, Director
MA Division of Marine Fisheries
100 Cambridge Street
Boston, Massachusetts 02202

Dear Mr. Coates:

As you already may be aware, the U.S. Army Corps of Engineers (Corps) is conducting a navigation improvement study (107) for Aunt Lydia's Cove in Chatham, Massachusetts. In January 1987, Nauset Beach, located due east of Pleasant Bay was breached. This breach has expanded to a width of about two miles. As a result, Aunt Lydia's Cove is exposed to the open ocean. A very dynamic shoaling problem as well as increased wave action now exists. This is causing increased damages and delays to the fishing vessels and the municipal fish pier.

Due to the complexity of this problem, a scoping meeting was held on December 19, 1990 with other agencies to narrow the list of alternatives to a reasonable number. The results of this meeting indicated that, from an environmental viewpoint, "softer" structural alternatives are more acceptable than "hard" structures, such as jetties or bulkheads. The following is a list of alternatives which will be considered:

1) Transfer the fishing fleet to Stage Harbor in Chatham. An existing Federal navigation channel currently exists at Stage Harbor.

2) Establish and maintain a Federal navigation channel and anchorage area at Aunt Lydia's Cove. The channel could entail just the spar channel south of Tern Island, or extend out through the beach.

3) Similar to #2 except the spar channel would go around the north end of Tern Island.

4) This alternative would include a wave fence, floating breakwater, or some form of jetty to the south of the cove that would alleviate storm damages and shoaling if possible. A connecting dike between the south end of Tern Island and mainland would also be considered.

5) Combination of numbers 2 and 4.

6) Combination of numbers 3 and 4.

Disposal sites to be considered include Tern Island (stabilizing the island is needed); nourishment of nearby beaches, nearshore disposal east of Nauset Beach; the west side of Nauset Beach; intertidal, subtidal areas, and/or accreting shoals within Chatham Harbor; and a containment area along the mainland south of Tern Island, with vegetative planting. Selection of a disposal site(s) will be dependent on the site's ability to accommodate dredged material over the 50-year life of the project, and it's environmental acceptability. A map outlining the potential alternatives and disposal sites is enclosed.

Alternatives which will not be evaluated in-depth include actions which would alter the breach, such as filling or stabilizing the breach, extensive breakwater embankment structures, and underwater scouring devices.

Your comments on the above alternatives are requested to ensure that an environmentally, as well as economic, social, and engineering acceptable solution is selected. Comments on known natural resources in the project area are also invited. Any questions or comments can be addressed to Ms. Catherine Demos at (617) 647-8231.

Sincerely,

Joseph L. Ignazio
Director of Planning

Copy Furnished:
Mr. Paul Carauso
Mass. Division of Marine Fisheries
18 Route 6A
Sandwich, Massachusetts 02563

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

December 10, 1990

REPLY TO
ATTENTION OF

Planning Directorate
Plan Formulation Division

Captain P.L. Collom
Chief of Staff
First Coast Guard District
U.S. Coast Guard
408 Atlantic Avenue
Boston, Massachusetts 02210-2209

Dear Captain Collom:

I am writing in response to your letter of November 20, 1990. We at the New England Division are aware of the critical situation that exists at Aunt Lydia's Cove in Chatham, Massachusetts. We agree that provision of a safe navigable waterway at Aunt Lydia's Cove is of utmost importance to continuing your important rescue operations.

The purpose of the feasibility study we are conducting, together with the Commonwealth of Massachusetts and the town of Chatham is to determine if Federal participation in navigation improvements to the Cove are warranted and to select the best solution to the problem. The timeframe we envision for implementation of a Federal project is three years.

We recognize this long term solution process to the problems at Aunt Lydia's Cove does not solve the Coast Guard's current needs. Without an existing Federal project at the Cove, the Corps cannot take any immediate corrective action. At this time maintenance of a navigable waterway is the responsibility of the Commonwealth and the town.

Dredging of the Cove was last completed in the fall of 1989. Continued shoaling requires that it be dredged again. The town has stated it is planning on dredging the channel again this winter.

In the meantime the Coast Guard will be kept abreast of the feasibility study progress. Information provided by the Coast Guard is necessary to the study and will be part of our findings. If you have any questions or further concerns, please do not hesitate to contact me or Mr. Christopher Hatfield, the Study Manager, at (617) 647-8520.

Sincerely,

Philip R. Harris

Philip R. Harris
Colonel, Corps of Engineers
New England Division

(o)
(617)223-8460

11460
NOV 20 1990

Lieutenant Colonel Stanley J. Murphy
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Col Murphy,

I know you are well aware of the significant shoaling problem in Aunt Lydia's Cove and Chatham Harbor, Massachusetts. I understand that the Corps of Engineers will join with the Massachusetts Division of Waterways and the Town of Chatham to conduct a Feasibility Study of navigation improvements in the area. This letter is to present the Coast Guard's view on the matter.

The Coast Guard maintains a multi-mission station in Chatham with the primary missions of maritime search and rescue and law enforcement. The station's area of responsibility (AOR) includes the waters south and west of Chatham in Nantucket Sound and the Atlantic Ocean waters east of Cape Cod within approximately a 20 mile radius of Chatham. The station uses different types of boats to conduct its missions, including heavy weather motor lifeboats for use in surf and stormy seas. One or more of these boats is always on immediate standby for search and rescue response.

The geography and topography of the area surrounding Chatham is such that the Coast Guard finds it necessary to locate its Chatham boats in two different locations in order to be able to respond in a timely manner in the two distinct portions of the AOR--Nantucket Sound and the ocean east of the Cape. A ready boat is maintained in Stage Harbor to respond in the Nantucket Sound area; a second boat is maintained in Aunt Lydia's Cove for ocean-side response. Because it takes up to three hours to transit from one portion of the AOR to the other via Pollock Rip Channel south of Monomoy Island, one ready boat cannot cover both areas and meet established criteria for responding to urgent search and rescue.

Thus the Coast Guard is gravely concerned with the worsening shoaling problem in Aunt Lydia's Cove. Already it hampers our response capability as our boats are grounding on the lower half of the tide cycle and cannot get to sea. While we are considering temporary moorings in Chatham Harbor for the immediate future, we will not be able to continue that

arrangement in the cold and storms of winter. The channel must be dredged immediately, and maintained at a safe navigational depth, if we are to maintain a fully operational Coast Guard Station at Chatham.

Sincerely,

P. L. COLLOM
Captain, U. S. Coast Guard
Chief of Staff, First Coast Guard District

Copy: U.S. Coast Guard Station Chatham

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Management

DIVISION OF WATERWAYS

349 Lincoln Street
Bldg. #45
Hingham, MA 02043
(617) 740-1600

May 14, 1990

Colonel Daniel M. Wilson
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Re: Federal Navigation Project
Aunt Lydia's Cove
CHATHAM

Dear Colonel Wilson:

The Division has reviewed the Corps of Engineers' General Investigation Report on the coastal breach at Nauset Beach, and the recommendation for a Federal project to dredge the main channel and a anchorage area at Aunt Lydia's Cove. The Commonwealth is prepared to enter into a Feasibility Cost Sharing Agreement (FCSA) with the Corps for a feasibility study for the project, and has been assured of cooperation at the local level.

A minor agreement has been prepared and signed by the Town of Chatham for matching of cost sharing with the Commonwealth for this project. We have received copies of the FCSA agreement from the Corps, and will be obtaining the necessary state approvals as early as possible.

If you have any questions, please contact myself or Leslie Lewis, Rivers and Harbors Program, at (617) 740-1602.

Very truly ~~yours~~,

Eugene F. Cavanaugh
Director and Chief Engineer

cc: James Lindstrom, Chatham Executive Secretary
Senator Henri Rauschenbach

TOWN OF CHATHAM

Office of the Selectmen

May 9, 1990

Donald Birmingham
U.S. Army Corps of Engineering
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Re: Chatham Harbor Dredging

Dear Don,

This is to advise you that at its meeting of April 17, the Board of Selectmen approved participating with the Army Corps of Engineers in the Chatham Harbor Navigation Improvement Feasibility Study and to use funds which have already been appropriated for that purpose.

At its meeting May 1, the Board accepted a grant from the Commonwealth of Massachusetts for one-half the local cost of this project in the amount of $55,000. As a result, we have all the local funds committed towards this project. Please advise what steps must be taken next to get this project underway.

Please note that the Commonwealth must make its cash contribution to the project by June 30, the close of its fiscal year.

I believe you are also aware that the Town would like to modify the scope of study to include appropriate measures to protect the Chatham Fish Pier from excessive wave action and prevent shoaling in its vicinity.

Very truly yours,

James A. Lindstrom
Executive Secretary

TOWN OF CHATHAM

Office of the Selectmen

August 10, 1989

Colonel Daniel M. Wilson
Division Engineer
US Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Wilson:

This letter is to seek the assistance of the Corps of Engineers under Section 107 of the 1960 River and Harbor Act, as amended, in implementing navigation improvements in Chatham Harbor, Chatham, MA.

Chatham Harbor has been the subject of Congressionally -authorized reconaissance survey performed by CENED Planning Staff over the last year. Preliminary results released last week indicate Federal involvement may be warranted. The Town of Chatham would like to begin the next step as soon as possible under Section 107.

Please contact James Lindstrom, Executive Secretary, at (508) 945-2100 for further coordination.

Very truly yours,

Andrew P. Young, Chairman
Board of Selectmen

cc: Mark Forrest, US Representative Studds
Captain Anthony Pettit, Commander, USCG Group Woods Hole
BMC J. Downey, OIC, USCG Station Chatham
Peter Ford, Harbormaster